COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

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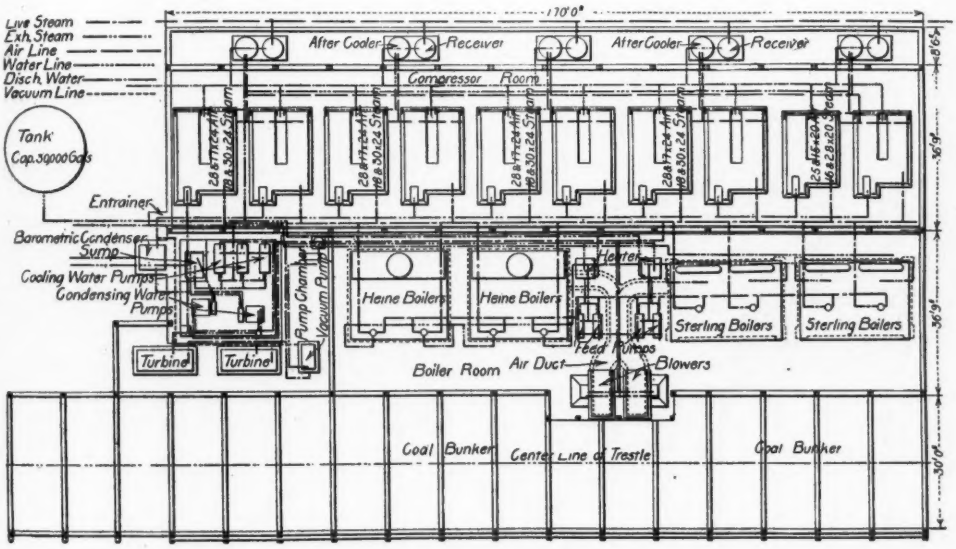
COMPRESSED AIR FOR THE RONDOUT SIPHON

One of the most important contracts on the Catskill Aqueduct work for increasing the New York water supply is that for constructing the Rondout siphon, near High Falls, Ulster county, N. Y. This was awarded to the T. A. Gillespie Company of New York, whose bid of $6,290,803.50 was the lowest.



GENERAL LAYOUT OF POWER PLANT.

There are three different types of aqueduct construction included in the contract: pressure tunnel, tunnel on the hydraulic gradient and aqueduct in open cut. The pressure tunnel siphon is 4.5 miles long. It is being driven from eight shafts which range in depth from 374 to 710 feet. The tunnel on the hydraulic gradient has a total length of about 7,000 feet, while the cut and cover aqueduct amounts to only a few hundred feet. The time allowed for the contract is 4½ years. The whole work covers a stretch of country some five miles long, and among the more important quantities estimated are: 4,150 feet of shaft, 27,000 feet of tunnel and 143,000 cubic yards of concrete.

sively for the operation of machinery, including drills, hoists, pumps, grouting apparatus, pneumatic tools and other small machines, so that the methods of obtaining and delivering this power are of the first importance. The work will be in progress so long that the daily

Compressed air will be used almost exclu- cost of maintenance and operation of plant were given as serious consideration as was the first cost of machinery and equipment. One large central plant was determined upon for the entire work. Although the first cost of the plant which the Gillespie Company has installed is large, it is believed that in the long run the expense will be amply repaid by the low operating costs and the more satisfactory progress of the work as a whole.

High Falls, on the Kingston division of the New York, Ontario & Western Railway, is the station nearest to the site of the work. A location for the power house was secured on the banks of Rondout Creek between shafts 4 and 5, about half a mile from the High Falls station, easily accessible from the railway line with a supply of good water near.

The power house is a wooden building about 82x170 ft., and rests on concrete foundations. A direct connection between the railway and the plant has been established by a spur track 3,000 ft. long. There are turnouts to store houses and a lumber yard. The spur track terminates at the station in a wooden trestle 500 ft. long, which crosses a highway and reaches the power house at a sufficient elevation to drop the coal into the bunkers. The contractor has also erected a machine shop, cement storehouses, an administrative office, a 200-ft. Howe truss bridge over Rondout Creek for carrying the air line and for transportation purposes, telephone lines, and has built a compressed air pipe line about 5 miles long, 12 in. in diameter at the power house and 8 in. at the farther ends of the line, besides constructing a number of new roads and repairing old ones.

The plant has four 250-hp. Stirling boilers and two batteries of Heine boilers, each of a capacity of 375 hp. The waste gases are carried off through six guyed stacks, one for each Stirling boiler and the other two for the Heine batteries. No. 3 buckwheat coal is used, hand fired. The ashes are removed in wheelbarrows, dumped outside and used for road building. Forced draft is furnished by two blowers, under the Acme control system. The engines for the blowers are built by the American Blower Company. The feed water is taken from the creek through a 24-in. vitrified pipe and delivered by four Buffalo pumps to the boilers. It is warmed by two Cochrane feed-water heaters.

The boilers furnish steam through a 12-in. header to ten high-pressure, high-speed cross-compound air compressors. The steam piping arrangements and the introduction of valves at numerous points permit the cutting out of any number of units in case of accident, without interfering in any way with the others. All compressors are Ingersoll-Rand Imperial type 10 Corliss machines, mounted on concrete beds. Their combined capacity is about 24,000 cu. ft. of free air per minute. Two of the compressors have a 20-in. stroke, with air and steam cylinder dimensions of 15 and 25 in. and 16 and 28 in. respectively, with an air capacity of 1,700 cu. ft. of free air per minute each; the other eight have a 24-in. stroke and air and steam cylinder dimensions of 17 and 28 in. and 18 and 30 in., with an air capacity of 2,400 cu. ft. each. The low pressure air varies between 30 and 35 lb. per square inch, and is raised on the high-pressure side to 110 lb. per square inch, the working pressure at the ends of the lines being only about three pounds less than this.

The air cylinders are water-jacketed and the cooling system operated by three Deane pumps having a capacity of 500 gal. each. Only two of these pumps are used ordinarily, the third being held in readiness in case of breakdown. The cooling water is pumped into a 10-in. pipe fitted with a 6-in. branch line which leads to a 30,000-gal. tank. Water is pumped direct into the main lines, the surplus going through the 6-in. branch into the tank, from which a circulation by gravity can be secured. The water is wasted into the creek from the compressors. The jacket water is discharged openly into funnels placed in conspicuous places above the air cylinders, so that the flow can be observed readily. If for any reason the cooling system fails to operate, the stoppage of the flow of water into the funnels indicates this fact, so that the trouble can be remedied or the engine stopped before the cylinders become excessively hot.

The cooling of the air takes place in both an intercooler between the low and the high pressure cylinders of each compressor and also in an aftercooler connected with each pair of machines. From each aftercooler the air enters an air receiver close to it and then passes into the pipe line. The piping and valves between compressors, intercoolers and receivers, as is the case with the steam connections be-

tween the boilers and the compressors, are so arranged that should one aftercooler be disabled or require cleaning or other attention the air from the two compressor units which feed into it can be at once diverted into the adjoining coolers.

The use of the aftercoolers in connection with the receivers is a commendable and a profitable, but hitherto an unusual, refinement of practice. The thorough cooling of the air thus accomplished enables it to drop its surplus of moisture in the receiver, which it would not do if it passed through the receiver hot, so that later choking of pipes or freezing up of exhaust passages in the drills or elsewhere is avoided. The complete cooling of the air at the beginning also reduces its volume and consequently makes an appreciable difference in the maintenance of flow in the lines before the work is reached.

The pipe line is buried for its entire length, except at Rondout creek, where it is carried across on the bridge previously mentioned. The air line at the power house, and for the greater part of its length is 12 in. in diameter. The 12 in. pipe extends in a general north and south direction from the central plant as far as shafts 3 and 6, respectively. Here the size is reduced to 10 in. These 10-in. lines feed air to shafts 1 and 2 on the north end and 7 and 8 at the south. Throughout its entire length the pipe line is fitted with the Dresser joint. With it there are no abrupt changes in direction, as is often the case when ells or other fittings are used, and the comparatively low drop in pressure along the line is attributed in some measure to its use. The pipe on the bridge is encased in a wooden box.

The condensing equipment at the station is of the barometric type, and gives a vacuum of about 27 in., and 30 in. when the air pump connected with it is run. The hot condenser water is turned into the creek, as plenty of good boiler water is available, and the use of the hot water would necessitate the installation of oil separators. The air pump is generally used only in starting up, and is stopped when the condenser has reached its normal working order. The condenser water is supplied by two Wheeler centrifugal pumps, each of 3,500 gal. capacity.

At each shaft there is a reheater having a capacity of 1,200 cu. ft. of air per minute. It consists of an outer and inner shell, with an annular air space between, around which the air circulates. A coke oven is placed within the inner shell, heating the air and effecting a gain in efficiency of about 30 per cent.

The central plant runs continuously night and day, and is operated by a force working three eight-hour shifts. The work is well started. Several of the eight shafts have reached grade, headings have been turned and the driving of the pressure tunnel begun.

Mr. Robert A. Shailer is managing engineer on this contract for the Gillespie Company, and Mr. W. L. Canniff has been in charge of building the compressor plant.

The above account is abstracted, with slight interpolations of our own, from *The Engineering Record*.

CARE OF PNEUMATIC CARVING TOOLS

The life of a pneumatic carving tool, as well as its efficiency and satisfaction giving qualities during its life, is fully as dependent upon the care given it as upon the work it has to perform, and a little attention devoted to keeping it in proper condition will pay many times over for the slight trouble involved.

The highly polished, accurately fitted surfaces of the working parts of a pneumatic tool are particularly susceptible to the action of rust, caused by dampness when not in use, and a tool should not be laid away, even over night, without the precaution being taken of dropping a few drops of oil into the inlet, connecting to the hose again and running the tool for a second, so that the oil will be carried through by the air and form a thin film on the internal working parts.

A much better plan, however, is to have a tank large enough to hold all the tools in use, filled with kerosene or gasoline, and when the tools are not in use keep them immersed in the oil. This serves a double purpose: the tools are kept from rusting and the gasoline or kerosene cuts and softens any deposit of oil and dirt in the air passages of the tool that may come from the compressor. The tool in the morning should be connected with the hose and thoroughly blown out, then disconnected, a little oil (just a few drops) used, then connect up and go ahead. A few drops of oil should be inserted at intervals of a couple of hours through the day. Use a light, limpid mineral oil, and on no account whatever use

an animal oil, such as lard oil, sperm, etc., as the tendency of these oils is to gum and clog up the air passages.

We have had many tools sent in for repairs with the complaint that they had lost their power, when the trouble lay in some, or all, of the air passages being almost entirely closed up by gummy oil, which had either been used in the tool, or had come through the pipes and hose from the compressor. The practice of keeping the tools in an oil tank will entirely overcome this trouble.

If a carving tool refuses to run, the trouble almost invariably will be that the piston or inside of the barrel has become roughened by a bit of grit, and the remedy for this is to take the tool apart and with a piece of fine emery or crocus cloth rub the abraded part of the piston smooth. It more often happens that the piston is roughened than the barrel. If it is found that the barrel also has suffered, whittle a stick to about the radius of the hole and with the emery cloth carefully smooth out the rough place. Then dip the tool in kerosene, blow out thoroughly with the air hose, put together and it will generally be found to operate satisfactorily.

A piece of this fine emery cloth should always be kept on hand for these emergencies, and if you cannot procure it at your local hardware store, write us and we will send you a sheet free of charge.

Never on any account allow a piston to be put on a grindstone to smooth down a rough spot, as the chances are that the piston will be ruined. [This is an awful suggestion. Ed. C. A.]

We urgently recommend that in all plants particular attention should be paid to the suction of the compressor. Air should never be taken from a room where stone-cutting is being done, as the air is filled with fine particles of grit, which are, in a case of this kind, constantly being drawn into the compressor and forced through the tools, with a consequent continuous grinding or cutting action. The ideal arrangement for a compressor suction pipe is to run it out through the roof of the shed and inclose the end of it in a framework two or three feet square, covered with a couple of thicknesses of fine muslin. When the plant is being installed, nothing but new, clean pipe should be used for conveying air to the tools, and every piece of pipe should be stood on end and hammered to jar loose any scale that may be on the inside, and every fitting should be inspected to see that it is perfectly clean. If old, rusty pipes and fittings have been used, you will have endless trouble and annoyances from dirt and scale coming through the pipes and hose to your tools. These precautions will give you a supply of cool, clean air, and the effective working life of a plant will be increased 100 per cent. over what it will be if installed and operated in the slipshod slovenly manner that many plants are.

The chisels used in carving tools should always receive constant and careful attention. The upper end of the bushing in the tool is provided with a shoulder, which acts as a stop for the end of the chisel shank, and the piston is proportioned as to length, so that when it comes down and strikes a chisel held up against this shoulder, the exhaust ports in the upper end of the barrel are opened just the proper amount to allow the air to escape from the upper end and the piston to make a full return stroke. Therefore, it is obvious that the shanks of the chisels should be kept ground square on the end and full size up to the end. If they are dubbed off at the end, or are so small that they pass up at all above this shoulder, they will prevent the piston from making the full downward stroke, the air pressure at the upper end will not be relieved, and the complaint will be made that the tool has lost its power. After long continued use the shoulder of the bushing will gradually be worn so that it lets the chisel up too far, and the same result of loss of power will be observed, but in this case it is better to send the tool in to the shop for adjustment and repair.

This matter of keeping chisels ground perfectly square on the end is important from another standpoint. When a chisel shank is round or not square on the end, the impact of the blow is not distributed over the entire striking surface of the piston as it should be, but is concentrated in one particular spot with a consequent extreme liability of fracturing the end of the piston. As a matter of fact, a far greater number of pistons are broken in this way than there are due to defects in the pistons themselves. We especially urge upon users of our tools the importance of this matter of chisel shanks, and attention to it will obviate needless expense and annoyance.

In screwing the tools on the hose, screw them on tight enough so that there is no looseness of the nipple in the head of the tools, otherwise the jar and vibration of the tool in use will soon destroy the threads of the nipple and in the head. It is a very good practice to use a male and female nipple screwed tight in the head and left there, then the threads in the head are protected and the nipple is easily replaced when worn out.

One more point in the use of tools should be observed, and that is to see that when the workmen lay them down temporarily, they are not thrown indiscriminately into a pile of dirt, as stone dirt and grit finding entrance through the lower end can do just as much damage as if it came through the hose from an unscreened compressor suction.—*W. H. Van Sickle.*

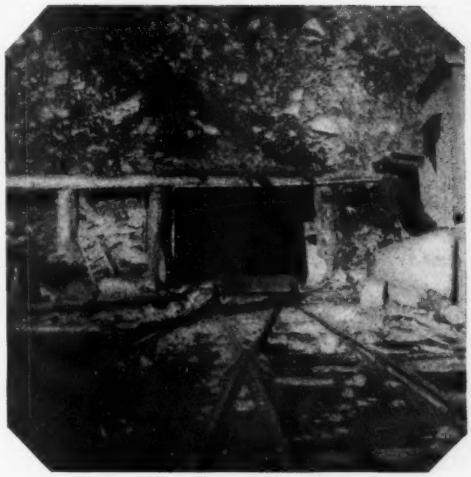


FIG. II.—OTIRA MOUTH OF TUNNEL.

FIG. I.—TUNNEL FOR WATER POWER.

THE HOLE IN THE HILL—A NEW ZEAL AND TUNNEL ENTERPRISE

We have received the first number of *The Hole in the Hill Magazine,* published at Otira, New Zealand. The hole in the hill from which the publication takes its name is the Arthur's Pass tunnel on the Midland Railway, now being driven from Otira to Bealey.

Although this work is about as far out of the way as well could be it is being carried on by the most advanced methods and with up-to-date facilities. The contractors before commencing operations made a study of the Loetchberg tunnel work, which doubtless largely determined the selection of equipments Within workable distance from the tunnel at each end water powers are available, so that electric transmission is employed, the plant at the tunnel comprising four Ingersoll Rand compressors, 24 Ingersoll-Rand 3 1-4 inch drills and several hammer drills. The accompanying half-tones are reproduced from the *Hole in the Hill Magazine.* Fig. 1 shows a small, short tunnel through which a wooden pipe was laid for driving the generators, Fig. 2 is the Otira mouth of the main tunnel and Fig. 3 shows a bit of Tunnel Town where the men live. We hope to give fuller particulars of this work later.

FIG. III.—BIT OF TUNNEL TOWN.

TRICKS WITH SOAP BUBBLES.

By Percy Collins.

[If the blowing of soap bubbles is not a compressed air operation we do not know what is, and our reproduction of the following highly interesting article from the pages of the *Scientific American* is justified both by its topic and by its exceptional intrinsic value to those who are interested in such lines of curious and ingenious experiment. Ed. C. A.]

Probably most people are of the opinion that bubble blowing is a purely childish pastime. But this is a mistake. Soap bubbles may be conveniently employed to demonstrate certain physical laws. Take, for example, the matter of surface tension. If we blow a bubble upon the bowl of a clay pipe, and remove the stem of the pipe from our mouth, the bubble slowly collapses. This is because the curved outer and inner layers of thin film, being at a tension, press upon the interior air and drive it back through the stem of the pipe. Again, if we blow two bubbles from two pipes, and connect the stems of the latter by means of a rubber tube, the smaller of the two bubbles will collapse, while the larger will increase in size. The explanation of this is that the bubble of smaller radius has its surface layers more sharply curved, and therefore exerts a greater pressure on the air within than does the larger bubble.

The writer, however, proposes to deal with soap bubbles mainly as a means of entertainment, leaving the reader (if he be so minded) to work out for himself their scientific possibilities. It may be said at once that upon the solution used success in bubble blowing entirely depends. The least elaborate formula, good yellow soap properly combined with pure water, is probably the best. Much depends, however, upon the manner of mixing. Take a bowl of slightly warm water, and rub in it a piece of good soap until a strong lather is formed. Skim off every particle of the lather with a spoon, and proceed to test the solution. First blow a bubble about six inches in diameter from the bowl of a pipe. Then dip your finger into the coap solution, and attempt to thrust the former into the center of the bubble. If it does not collapse, the solution is ready for use. If it bursts in the ordeal, more soap must be added until satisfactory.

When once made, never disturb it. Many may think that occasional stirring will render it more uniform in strength, and better, but this is a great mistake; and the amateur will soon find that any disturbance of his solution will render tricks impossible that are otherwise quite easy to perform.

For artistic blowing, a little apparatus will be necessary. A straw or two, a clay pipe, one or two funnels of different sizes, and a ring made by twisting a wire round a bottle will be needed. Moisten thoroughly with the solution every article just before it is brought into use; and for this reason it is a good plan to keep one's straws standing in a half-filled jar or tumbler of soap solution.

For a pretty trick, attempt to form a string of bubbles—blowing one with the pipe, throwing it into the air, blowing a second, catching the first upon it, and so on until the chain collapses. With practice, a chain of five or six, or even more, bubbles may be formed. The trick has the advantage of demonstrating the quality of the solution if this be in question, and it is therefore a good one to commence with. Chain making is by no means as simple as certain other tricks which, at first sight, appear far more elaborate. For instance, it is quite an easy matter to blow a number of bubbles one inside the other. First pour a thin film of solution upon a sheet of glass, then dip your straw and blow upon the glass a good sized hemispherical bubble. Now dip the straw again, thrust it boldly through the side of the big bubble, and proceed to blow a somewhat smaller bubble inside. Repeat the process as often as possible, and a very pretty series of iridescent hemispheres will be the result. An accomplished bubble blower will sometimes form a dozen before the inevitable dissolution ends his triumph. Much depends upon the steadiness of hand and eye.

A variation of this trick takes the form of a "poached egg." First, a large bubble is blown upon the sheet of glass in the ordinary way; then a "pull" is taken at one's pipe or cigarette, the while the straw is redipped, and the second bubble within the first is inflated with smoke instead of air. The result is a beautiful white, solid-looking hemisphere within another shining with rainbow colors.

A good deal of fun at a bubble party may be secured by asking a novice to place a bubble upon a flower. He will make attempts, but

SOAP BUBBLE TRICKS.

without success. Then the master of the ceremonies will do it with ease, as his flower is first secretly smeared with soap solution, which provides, so to speak, a "foothold" for the bubble. Both smoke-filled and clear bubbles may be used effectively; and a number of flowers of different kinds may be adorned. If the solution be strong and good, it is quite easy to make a dozen or more "bubble flowers" before the first one bursts.

The wire ring may now be brought into play with somewhat astonishing results. An ordinary hemispherical bubble may be blown upon the sheet of glass, and then drawn up with the ring to form a cylinder. Of Course, the ring must be first dipped in solution, when it will be found to adhere tenaciously to the outer surface of the bubble.

By blowing a bubble with the pipe, throwing it into the air, and then catching it with two rings of soaped wire, the bubble may be pulled into a barrel shape.

An elliptical bubble is made by first dipping a wire ring into the solution, so that a film stretches across the opening; then, with a straw, blowing a bubble upon this film. Two bubbles are actually formed in close contact, the result resembling an old-fashioned lens, as shown in the half tone.

Another very effective trick may be described as the opening and closing flower. A five-pointed corolla should be cut out of rather thin white paper, mounted with a pin point upon the cork of a small bottle, and well smeared with soap solution. Upon this a good-sized bubble is to be mounted. If the bubble does not of itself pick of the rays of the corolla, they may be quite easily adjusted as pictured. When these preparations are complete, it is an easy matter to make the flower open or close by thrusting the straw into the bubble, and either sucking out air, or blowing it in.

We may wish to blow a bubble over a flower or any other object. Begin by placing the flower upon the sheet of soapy glass, or in a shallow saucer containing a little solution. Over the flower put a funnel of suitable size, and start to blow gently down the tube, the while you cautiously raise the funnel. Continue to blow until a sufficiently large bubble is formed. Then disengage it from the funnel by turning the latter carefully at right angles, the finger being applied to the opening of the tube. To accomplish this feat (shown in the illustration) calls for a little practice; but the novice will generally succeed after three or four attempts.

One may vary it by blowing a bubble over a small statuette or ornament, previously preparing the same by fixing a tiny circle of paper well damped with soap solution upon its summit by means of an atom of cobbler's wax Then, upon this platform, a little smoke-filled bubble may be blown, as shown in the photograph.

A bubble may be blown over a little pinwheel, made from paper, a small cork being used as a support. The wheel may be set in rapid motion within the bubble by a current of air blown through the ever-useful straw, the bubble increasing in size as long as the wheel is kept spinning.

The foregoing hints by no means exhaust the possibilities of the art.

But pipes, funnels, straws—everything, in fine, that a bubble is to be blown from, or is to touch—must be thoroughly anointed. For if one tries to blow a bubble from a dry pipe or funnel, or to transfer a bubble when blown to a dry surface, that bubble will certainly burst. This fact need not be divulged at the outset to onlookers. Indeed, a vast deal of fun may be derived from the failures of novices to imitate the tricks which the accomplished blower performs with much ease.

Bubble parties have proved a great success. Their nature should be indicated upon the cards of invitation, and preparations made before the hour of meeting. A large table is necessary; and should it have a polished surface likely to be damaged by the soapy water, a mackintosh sheet should be spread. Each guest must be provided with a chair and the materials. Two or three glass funnels are sufficient and these should be carefully tested, as the rim of each must be quite true. A glass funnel enables one to get the object in the center over which the bubble is to be blown.

Pretty bowls and saucers, and dainty little ornaments, add greatly to the beauty of a bubble "set piece," such as some of those shown herewith. A bubble may just as readily be blown in a dainty saucer or other piece of china, by means of a funnel, as upon a flat sheet of glass, while the result will be infinitely superior.

[It is of course understood that soap bubbles and their accompaniments are not the best subjects in the world for the photographer, and the pictures grouped in the halftone may be considered remarkable triumphs of the art in themselves. Ed. C. A.]

The titles are as follows:

Top row: Raising funnel to complete bubble over object. Blowing bubble over object

by aid of funnel. Blowing a chain of bubbles. Apparatus for blowing bubbles.

Second row: Small statuette inside a hemisphere. Smoke-inflated hemisphere inside rainbow colored one. Flower shown after disengagement from funnel.

Third row: Bubble mounted on rays of flower. Straw kept in solution ready for bubble blowing. Smoke bubble adorning a flower.

Fourth row: Hemisphere blown over pinwheel. Large bubble pierced for blowing a series of smaller ones. Many hemispheres may be formed before dissolution.

Fifth row: Bubble adorning flower; a dozen may be added. An elliptical bubble made by aid of wire ring. Hemisphere drawn up with a ring to form cylinder. Rays of flower closing in the bubble.

PNEUMATIC BRIDGE CAISSONS IN GREAT BRITAIN

In a recent paper before the Institution of Engineers and Shipbuilders in Scotland, Mr. Andrew S. Biggart described the operations in construction of a number of large bridges in Great Britain, in each of which undertakings the pneumatic caisson was a prominent feature, the work all executed by the firm of Sir William Arrol & Company (Limited) Glasgow.

The Clyde Bridge of the Caledonian Railway Company has five deck spans from 60 to 200 ft. long, carrying at one end nine tracks and at the other end thirteen tracks. Each of the river piers has five cylindrical columns seated on brick piers with rectangular pneumatic caisson foundations. The caissons are of steel and each of them had three 3½-ft. air shafts and was built on a falsework extending across the river, which also provided for the delivery and storage of materials and for the subsequent erection of the superstructure. Two wooden trestle bents were erected on the falsework on opposite sides of each caisson and each pair supported a pair of horizontal riveted steel plate girders forming gallows frames over the caissons. Four vertical rods, one near each corner of the caisson, were connected to the caisson and, passing between the pairs of girders, engaged saddles commanded by hydraulic jacks. The caisson was lowered by the jacks to water level, concreted and again lowered and released from the suspending rods and concreted until it took bearing on the river bed. During this operation the caisson was maintained in horizontal position by guys, but rose and fell with the tide.

The bridge over the River Barrow in the south of Ireland has thirteen 140-ft. fixed spans and one 215-ft. swing span with 15 piers, each made with two 8-ft. cylinders 26 ft. apart on centers which had their bases extended to a diameter of from 10 to 15 ft. The lower portions of the cylinders were made with steel rings up to about the bottom of the river, and above that the cylinders were made with cast-iron rings. The cylinders were assembled on lateral extensions of a wooden falsework platform built across the river, the working chamber and the adjacent cylinder rings were lined with concrete and lowered to the river bottom by hydraulic jacks. The excavation in them was partly made by grabs, but in every case was finished under pneumatic pressure. The upper rings were added and concreting between the air shaft and the rings was continued as the cylinders sank. Although they were carried down to an extreme depth of 120 ft. below high water level, the pressure was reduced by special measures to a maximum of 45 lb. per square inch. This was mainly accomplished by the use of ejectors operated by compressed air to remove the water which came in under the cutting edge. The usual precautions were taken for the safety of the workmen by reducing the hours of work, restricting the speed of their exit, and providing warm refreshments and rest for them immediately after emerging from pressure. After the working chamber was concreted the air pressure was maintained on it for several days. The top ring of the cylinder was made of special depth to bring the upper edge to the required level. The cost of excavation at the maximum depth reached $200 per cubic yard.

The Suir Bridge, near the Barrow Bridge, carries the same single track railway on nine spans of about 140 ft., with cylinder piers similar to those of the Barrow Bridge, but not sunk to so great a depth. When one of the cylinders had been sunk to a depth of 70 ft. below the river bottom and subjected to a pressure of 32 lb., one of the cast-iron rings, just below the bed of the river, burst, under a tensile stress of about 1,000 lb. per square inch. The casting had been satisfactorily tested be-

fore acceptance and pieces of it were tested after the accident and gave results up to the specifications without disclosing any flaw in the metal. No explanation has been offered for the break. A wooden cofferdam was built around the top of the cylinder and pumped out, and the broken ring was removed and replaced by a new one and a concentric steel shaft 3 ft. in diameter was set in it and extended down through the concrete lining to a point 5 ft. below the upper end of the steel portion of the cylinder. The lower 9 ft. of this shaft was then grouted to the concrete filling, the air lock was placed on top of it, and sinking successfully completed.

The Black Friars Bridge over the Thames, in London, has five flat steel arch spans of 155 to 185 ft., which were recently enlarged by extending the width of the structure from 43 to 73ft. This involved a corresponding extension of 30 ft. at one end of all the piers, which were of masonry and were each supported on several rectangular pneumatic caissons and one triangular caisson forming a cut-water at the upstream end, where the extension was made. Pile falsework platforms were made enclosing the upstream ends of the piers and extending 10 ft. beyond the pier on each side and 60 or 70 ft. beyond it upstream. Steel pneumatic caissons for the foundations of the pier extensions with a semi-circular cut-water on the upstream end and a recess on the downstream end to fit the nose of the old cut-water, were assembled and riveted on the falsework. The downstream end of the caisson did not, however, reach entirely to the main part of the old pier, but left a narrow gap there on each side of the downstream end of the old cut-water. The caissons were assembled by steel stiffleg derricks installed on the falsework platforms. A timber trestle was built parallel to the axis of the caisson on each side of it on the deck of the falsework platforms and two pairs of steel plate girders were seated on them, one at each end of the caisson, provided with vertical rods and hydraulic jacks by which the caisson was slightly lifted while the supports under it were removed. Concrete was filled into the cutting edge and on the roof of the caisson and it was lowered to the bottom of the river, the sides being carried up by a temporary steel cofferdam continuous with them and heavily braced with interior timbers as it descended. The caissons were sunk just below the bottom of the river and the side spaces between the old and new caissons were enclosed by wooden cofferdams which were pumped out, allowing them to be excavated and concreted.

After one of the caissons had been lowered a few feet below high water and was still suspended from the overhead girders, the hydraulic jack which supported one of its corners was prematurely exhausted, relieving the opposite diagonal jack of its load, throwing the entire 250-ton weight of the caisson on the remaining two jacks and settling the piles under one of them a few inches. This movement caused the caisson to swing and the falsework to collapse, precipitating the caisson to the bottom of the river. The caisson was then braced by interior cross girders and web plate brackets and the point was lifted by hydraulic jacks operating bars suspended from two box girders braced together on the falsework platform. The caisson was then moved to proper position on sliding bearings and was sunk in the usual manner.

TWO ELECTRIC-AIR DRILL RECORDS, WITH COSTS

The Brier Hill Colleries of Crawford, Tenn., have been using one of these drills, a 5 D, in their mines for about 18 months for drilling holes in the roofs of several entries. The rock varies from slate to sandstone and conglomerate rock, and Mr. E. B. Taylor, general manager of the mines, who has kindly furnished us with the information regarding this drill, states that the drilling was done through the hardest roof he had ever encountered in 30 years' mining experience.

A 5 D drill is equivalent to an Ingersoll-Sergeant 3½-in. air drill, and has a stroke of a little more than 8 in. It will drill a 16- ft. vertical hole from 1¾ to 2¾ in. in diameter. It has a 5½-HP. motor. Such a drill is intended for the heaviest work in large tunnel headings, open cut work in quarries or railroad grading, or in shaft sinking, or mining.

During 16 months' work with this drill, holes were drilled in the roof of the main entry of one mine, a distance of 600 lin. ft., in driving three entries of another mine, a distance of 250 ft. in a new haulway, 200 ft. in the 2d left entry, and 275 ft. in the 3d left entry.

These three entries were driven simultane-

ously, the drill being moved from one entry to another as it was needed. Only one hole was drilled in the roof of each of these entries each day, the average depth of a hole being 7 ft. It took the drill runner and a helper from 20 to 30 mins. to unload the drill from a car and set it up, while the hole was drilled in about 20 mins. About a half day was consumed in drilling the three holes and making the necessary moves, more than three-quarters of the time being taken up in moving and setting up the drill.

With wages for the drill runner at $3.50 for a 9-hour day and $2 for the helper, this gives a labor cost of 13 cts. per lin. ft. of drilling. Upon one occasion the crew drilled 7 holes in a 9-hour shift, aggregating 42 ft. 6 ins., which substantiates the cost of 13 cts. per lin. ft. Mr. Taylor states that during the 16 months this work was going on, outside of sharpening the steel bits, not one cent was spent in repairs or for maintaining the drill—a rather unusual record for any drill.

The Superior Portland Cement Co., of Superior, Ohio, have three 5 C size of these drills at work in their limestone quarries. We are indebted to Mr. J. B. John, manager of the company, for the following account of work done by these drills.

The vein of limestone averages about 8 ft. in thickness. To blast out this limestone, holes 6 ft. deep and 2½ in. in diameter are drilled. Each drill puts down, on an average, 17 of these holes per day. Thus three drills do 306 lin. ft. of drilling per day. There is blasted out an average of 500 tons of limestone per day, equivalent to 220 cu. yds. This gives an average of 1.4 lin. ft. of drilling per cubic yard of rock blasted, place measurement.

With wages for the drill runner at $3.50 per day, and helper at $2 per day, this gives a cost for labor for drilling of 5.4 cts. per lin. ft., and 7.5 cts. per cu. yd. of rock blasted, which is a very low cost, accounted for, however, by the rapid drilling done by this machine.

Another factor that enters into the rapid work done by one of these drills is its tremendous back-pull or stroke, making the drill work itself loose in a bad hole and preventing it becoming "stuck." Even when the steel binds, there is a pull and push on the piston, at full power, for every revolution of the pulsator; and this works it loose almost instantly. Mr. John states that the wear and tear on these drills has been very light.

The method of moving the pulsator and dynamo in the quarry was very simple. These two are mounted on a common bed which has two sets of wheels under it. A cheap wooden frame for a track was made in sections, for the truck to run on. Only a few of these sections were needed and they were light, inexpensive and easily handled. Small steel rails can also be made up in sections and used in the same manner, and naturally they will give better service, as well as allow of a better joint being made between the sections. When a good hard bottom occurs in the mine or quarry, the pulsator and motor can be moved from place to place without any track, the wheels running directly on the rock. On tracks it can be carried over rough ground or muck piles with the aid of blocks and tackle.—*Engineering-Contracting.*

ELECTRIC MOTORS FOR COMPESSORS

By W. L. Wotherspoon.

The electrical air compressor is the result of an extended study of conditions on the part of both pneumatic and electrical engineers, and has shown itself peculiarly adapted for its work wherever electric power is available at a rate which makes its use commercially attractive. The process at the very root of mine production is the breaking of the rock, and thus far electricity has not been found equal to the demands of this situation. So long as the air drill holds its sway, compressors must be run, and the application of electrical power to the compression of air is an interesting problem which has taxed the skill of pneumatic and electrical engineer alike. The unit is composed of three distinct elements—the motor, the compressor and the method of drive—but in these notes the motor will be considered. The type of motor will be usually determined by the character of the current available. If it be from a direct-current source, a slow or moderate speed direct-current motor will be used. Such a motor may be operated at variable speed by means of some of the many methods of speed control, but this is a contingency which need not be considered in the average mining plant. For while the mine

load is a variable one, speed variation cannot be economically secured in a motor by electrical means, and fluctuations of load can be much more efficiently cared for by some of the standard motors which operate at a constant speed, assisted by regulators, than by a variation of piston speed and displacements. It may also be stated as a rule of practice that a variable-speed motor for driving a compressor has no place in the mine plant. When circumstances settle the use of an alternating current motor, the choice is usually between the synchronous and the induction types. The former has certain virtues and defects. In the first place, it is not self-starting, and requires some separate source of power—probably a small induction motor—to bring it up to full speed before any local can be thrown upon it. The synchronous motor requires, moreover, a source of direct current to excite its field. Once up to normal speed, this type of motor is essentially a constant-speed machine, and within its limit of power capacity will maintain its speed regardless of fluctuating load. Should a sudden overload occur the synchronous motor drops out of step and stops. Some assert this an advantage acting in the nature of an auxilliary relief to prevent explosions or burnouts. It is also claimed for the synchronous motor that its power factor is unity, but this is true only when the motor field is correctly adjusted to the motor load, and any variation of that load will cause the current to lag or lead, as may be, and the power factor becomes a variable quantity. Where it is possible to vary the motor field automatically with the varying load, the power factor might maintain at unity, and this disturbing effect of the synchronous motor would be omitted.—*Journal of the Transvaal Institute of Mechanical Engineers.*

AIR RECEIVERS

The uses of compressed air are so varied that no definite rules can be laid down to cover all requirements of the receiver. That a receiver is desirable seems to be generally conceded, but the reasons for its use seem to be rather confused.

The most important functions of a receiver can be divided under four heads: To act as a temporary reservoir; to collect the water and grease and insure dry air; to reduce the loss caused by friction in the pipes, and to equalize the pulsations and steady the flow of air to the place of use.

The first function of a receiver that occurs to most people is that it will act as a reservoir of power. This is true, to a certain extent, if the receiver is made large enough, but in most cases this would require a receiver so large as to be prohibitory. For this reason the plan of using the receiver as a reservoir will never be satisfactory, and the extra money spent for the reservoir would be better used if expended in the purchase of a compressor of sufficient capacity to supply the greatest demand put upon it.

An idea of the size of receiver necessary to act as a reservoir can be had from the following example of a 24x30 compressor, running at 85 revolutions per minute at a working pressure of 110 pounds. It would require a receiver 5 feet in diameter and 60 feet long to keep up the work of the compressor one minute after it had been stopped and not allow the pressure to drop more than 15 pounds, while if the compressor was at work and the demand for air was 25 per cent. greater than the capacity of the compressor in four minutes it would lower the pressure 15 pounds. The real value of the receiver is when the demand for air is very irregular, the advantage being due to the fact that the compressor stores energy in the receiver without any great change in pressure when the demand for air is less. This saves the compressor from the hard usage caused by a varying change in the load, and avoids the loss caused by free expansion, which would result if no receiver were used. When the variation in the quantity of air used is very great, and a uniform pressure is required, an unloader is often used.

The receiver when properly connected serves as a means for removing the water and grease from the air. The inlet to the receiver should be at the bottom, and the outlet at the top. This applies to both the vertical and horizontal types. See Figs. 1 and 2. To each receiver should be fitted a pressure gage, safety valve and drain. The water and grease are drained from the air by allowing it to pause in its flow, to cool and to drop the water and grease which would otherwise be carried along by the current of air. If the receiver is too close to the compressor the air will not have time to cool sufficiently. The general practice is to

place the receiver about 50 feet from the compressor. If the air is not sufficiently dry to prevent freezing after having passed through the receiver, it may be farther dried by placing a separator in the pipe line, made as shown in Fig. 3. The shell is made from a 6, 8 or 10-inch nipple, according to the size

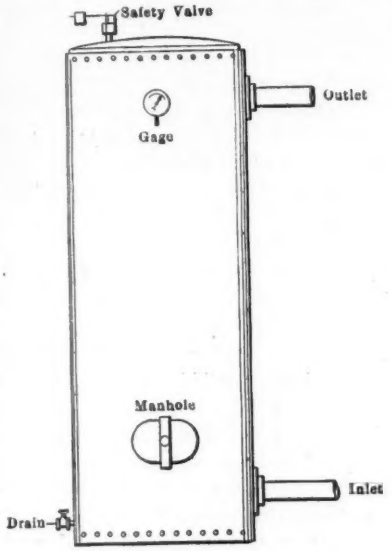


FIG. 1. VERTICAL RECEIVER

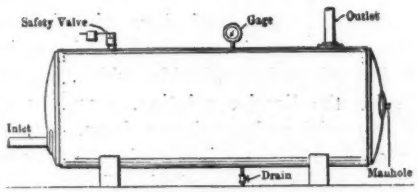


FIG. 2. HORIZONTAL RECEIVER

of air line, with caps screwed over the ends. The bottom cap is drilled and tapped for the drain, and the top cap for the inlet and outlet pipes. This separator should be placed at the end of the air line, and at the lowest point in the pipe system.

The air may also be dried by placing a second receiver at the end of the air line. This also is useful in reducing the loss by friction of the air in the pipe system. When air is quickly withdrawn from the pipe the pressure will momentarily drop below the average. If a receiver is placed as near the scene of action as possible this loss of pressure and the momentary fluctuations will, to a large extent, be prevented. Also, by keeping a uniform pressure at each end of the air line, the flow of air will be more uniform, and the pipe friction will then become a constant quantity, due to the average consumption of air and the difference in pressure of the two receivers at the ends of the pipe. Since the friction loss varies as the square of the velocity, it is readily seen that the loss is least when the velocity is that due to the average air consumption.

The fourth function, the equalizing of the pulsations and steadying the flow of air to the place of use, is similar in principle to the third function. As the air comes from the compressor into the pipe, the pressure will run up momentarily far in excess of the average pressure used, unless there is sufficient space for its immediate accommodation. This will throw unnecessary strain on the compressor, and also consume power. By placing a receiver in the air line this difficulty is relieved and a steady flow of air is sent into the pipe leading to the work.

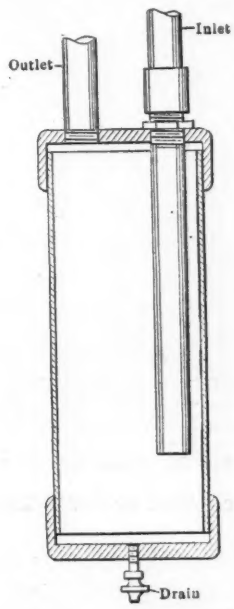


FIG. 3.—SEPARATOR.

The size of receiver required depends upon the rapidity with which the air is drawn from it, and the drop in pressure which is permissible. The size also depends upon the working pressure, and in general it can be said that the

greater the working pressure, the smaller the size of receiver that can be used for a given number of cubic feet of free air per minute. Fig. 4 is a diagram showing the general practice in selecting the size of receiver under ordinary conditions. For example, to find the size of receiver necessary for an 1100 cubic-foot machine at 110 pounds working pressure,

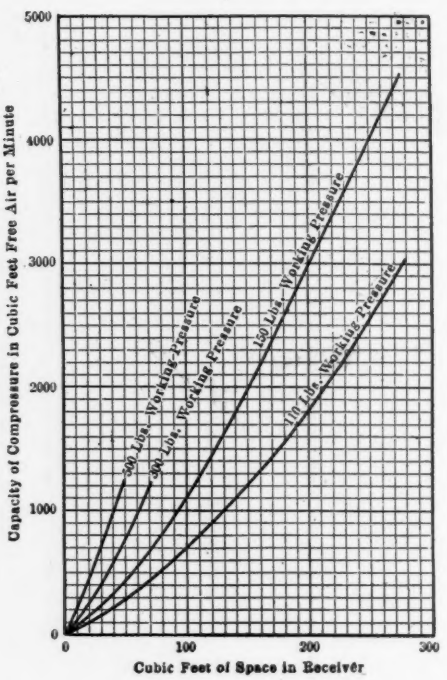


FIG. 4. CAPACITY OF AIR RECEIVERS

project across to the 110-pound curve, and then down to the lower margin, where the size is found to be 140 cubic feet. From this the dimensions of the receiver can be computed.

Receivers should be made of the best 60,000-tensile-strength steel. The side seams should be double-riveted, and strongly made with dished heads, and tested at a pressure 50 per cent. greater than the maximum pressure used. The larger sizes should be provided with manholes. To prevent too great an accumulation of water and grease, the drains of the receiver should be opened frequently.—*John B. Sperry* in *Power and the Engineer.*

[It will frequently or generally happen that little or no water will be drawn from a receiver placed near the compressor, while if the line is of sufficient length for the air to become thoroughly cooled and another receiver is placed at that distance, the air being still, water will be deposited requiring frequent drawing off and then leaving the air so dry that there is no trouble from water or from freezing up when the air is used. Ed. C. A.]

AN AIR EXCLUDING FIRE EXTINGUISHING COMPOUND

German fire departments have been investigating means and methods for extinguishing burning gasoline, benzine and other liquid hydrocarbons, the use of water for the purpose being so unsuccessful, and in consequence a novel compound has been brought out the use of which shows remarkable results. Two separate aqueous solutions are prepared, one of potash, alum and sodium sulphate, and the other of sodium bicarbide, sodium sulphate and licorice-root extract. These are contained in two chambers of a small metal cylinder with a long spout and so arranged that on being inclined or reversed the two solutions mingle as they flow. There is no pressure except that due to gravity, and consequently the liquid does not issue with sufficient force to cause a spattering of the burning hydrocarbon upon which it may be poured. The result of the chemical reaction between the alum and the bicarbonate is an immediate evolution of carbon dioxide which, in contact with the licorice solution, forms an exceedingly stiff and persistent foam. Such a layer of foam, containing an inert gas, upon the surface of a burning liquid effectually cuts off all access of air, and combustion necessarily ceases. The temperature of the liquid may have reached a sufficiently high point so that through evaporation bubbles of the vaporized hydrocarbon rise for a time through the stratum of foam, and tongues of flame play over its surface. These soon cease, however, for simultaneously with the evaporation of the carbon dioxide there is a loss of latent heat, the temperature of the foam-yielding solution falls, and this in turn cools down the combustible liquid. The foam extinguisher is believed to be specially applicable to automobile garages, motor yachts and places where combustible liquids are stored or handled for sale or otherwise.

A SUCCESSFUL AIR LIFT INSTALLATION.

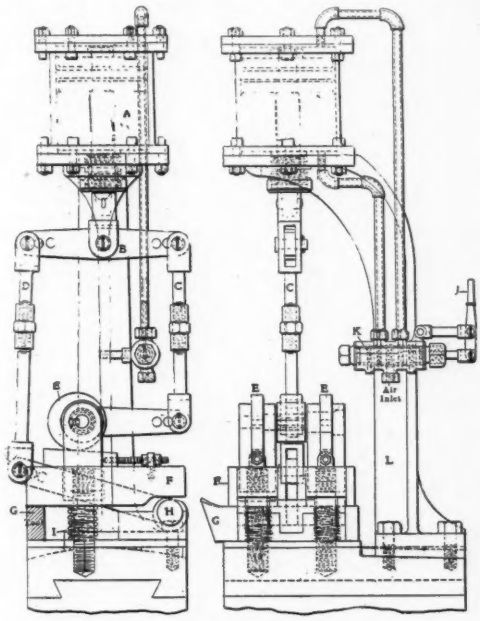
The city of Ottawa, Ill., depends upon flowing wells for its water supply; the increase of consumption has made the supply inadequate and lately the air lift has been installed with highly gratifying results. An Ingersoll-Rand Class A compressor 14 and 14¼x14 was placed in position and piped to four wells. These wells were 6 inch with a maximum aggregate flow of about 90 gallons per minute or, say, 500,000 gallons per day. The air pipe used in the wells was 2 in. carried down 100 feet, and when the air was turned on the tests showed a delivery of 2,500,000 gallons per day, while only 1,500,000 gallons had been guaranteed. The water supply is now much in excess of present requirements, so that the air lifts will not be operated continuously.

A PNEUMATIC TOOL FASTENER

The new so-called high speed steels for metal cutting tools have found nowhere a better opportunity for the display of their time saving qualities than in the turning of the tires of locomotive driving wheels in railroad shops. This is a job of constant occurrence and the speed at which it is now accomplished is continually astonishing the old timers of the shops. The rivalry of the different shops and the continued effort to make new records in this special operation have caused attention to be paid to all the details of manipulation with a view to the saving of time in all directions. The development and use of one of these time and labor savers is thus described by the designer of it, Mr. W. A. Anthony, Elizabeth, N. J., in the *American Machinist.*

Some time ago there there were installed in the Philadelphia & Reading Railroad Company's wheel shops at Reading, Penn., two 40-inch and two 90-inch tire lathes that were built by the Niles-Bement-Pond Company. As competition in turning out work is very keen, it seemed to me there was room for improvement. While observing the differences in the amount of work turned out, I started the designing and building of the automatic tool holder described below, and now, with its help, one man, on one machine, is turning out more work in one day than in any other place in the world.

With an operator well broken in, we found it possible to turn out 10 pairs of 36-inch wheels in 10 hours, by using these machines as they were received from the builders. By placing a tool bench back of the operator so that he would not have to move to place his hand on any tool he desired; by putting on his tool rests a pair of removable two-way ratchets that could make a complete revolution, thus making adjustment of his tools an easy matter, and by making a pair of adjustable skids that could be used for any size axle, in putting in, and taking out, the wheels, we



PNEUMATIC TOOL FASTENER.

increased the output to 12 pairs of 36-inch wheels in 10 hours.

The operator then claimed that his only drawback, in turning out more work was the time and labor lost in putting in and taking out the tools. As five pairs of tools are used in turning one pair of wheels, not counting the tools knocked out by striking hard spots, you will see that the adjustment of tools consumed considerable time and hard labor during a day's work. Each tool clamp has four 1½ inch nuts to tighten with a 40-inch wrench, thus making a total of 80 nuts to screw and unscrew in the turning of one pair of wheels.

With this automatic tool holder the time and labor has been reduced to a minimum, and one machine to-day is averaging 16 pairs of 36-inch wheels every 10 hours.

The design of this pneumatic tool holder is shown in the line cut. The air cylinder *A* is used with 90 pounds of air and pulls up the equalizing lever *B* and with it the eccentric rod *C* thus causing the cams *E*, with a 7-16-inch throw, to push down the tool clamps *F* against the tool *G* and hold them there. The difference in the throws of cams *E* and *H* allows a margin for placing and removing the tools and also causes the eccentric rod *D* to pull up the cams *H*, with a 3-16-inch throw, and thus push up clamps *F* in the rear and down in the front. This acts as a wedge and pinch bar, making the tool unmovable with one movement of the hand on the air-lever *J*. The springs *I* lift up the clamps F when the air is released, allowing the removal of the tool with ease. The valve *K* is a four-way air valve that is used both ways. The housing *L* is cast steel and fastened to the tool rest with six 7-8-inch studs.

EFFECTIVE DISCIPLINE

There are now ten apprentice schools on the New York Central Lines, with a total of 547 apprentices. Things are looked after in these schools as strictly as in any college. It is required of the boys, not to take too much of the shop time, that a considerable part of the problems which come up shall be done at home. The delinquent student in this college goes up before a faculty consisting of a division foreman.

"I find," said this Nemesis to a boy in the West Albany shop a little while ago, "that you haven't been working out the problems given to you, and that you're away behind."

"Yes, sir; I guess that's right."

"Well, you've got just one more chance. Work 'em or go get your time."

At shop time next morning the backslider walked up with a handful of problem papers, and all were solved.

"All these?" said the faculty, in surprise, "when did you do 'em?"

"Last night."

"H'm! It must have taken some time."

"It took all night. I haven't been to bed."

And having "worked off his condition," he went back to his job in the shops and put in a full day, and we may be sure that experience was not repeated.

HIGH PRESSURE GAS TRANSMISSION

During the past few years the apparatus for manufacturing and purifying gas has been greatly improved, and the many by-products obtained have found wide demand. To economically prepare these by-products in marketable shape requires a plant of comparatively large production, so that the tendency now is to centralize the point of manufacture for several neighboring communities, thus obtaining the benefits resulting from the disposal of the by-products.

This idea of a central plant supplying a considerable area, naturally implies the necessity of many miles of piping, which, applied to the ordinary low-pressure system with its large, heavy pipes, means a large outlay of capital. With the high-pressure system of gas transmission, these disadvantages are avoided and many additional advantages are obtained.

The installation of a compressor to accomplish this stepping up of the pressure from that at which the gas is produced to that at which it is transmitted, involves no complication of apparatus and no considerable outlay of capital. A large compressor is seldom necessary; and, with a suitable governing device, no special attention is required to insure perfectly reliable operation.

The standard types of air compressors used in steam and electric railroad service, and manufactured by the Westinghouse Air Brake Company, are well adapted for compressing gas for transmission at high pressure. They may be driven either by steam or by electric motor. The two types of compressors are illustrated in the accompanying half-tones.

The compressor is so located and connected as to draw the low-pressure gas directly from the gasometer, compress it and deliver it through a suitable storage reservoir into the high pressure main. For cases where the high pressure is required to be constant during the twenty-four hours, an automatic governor may be applied to the compressor, which regulates its speed so as to maintain the desired pressure practically constant. For cases where the high-pressure is raised to a certain maximum and allowed to decrease to a fixed minimum, a governor may be furnished which will stop and start the compressor within this desired range of pressures.

The following application illustrates the

simplicity of this system. An Eastern municipal gas and electric light plant supplies three neighboring towns. It is situated in the central part of one town and is from three to four miles from the others. The whole town where the plant is situated is supplied with low-pressure gas, flowing directly from the gasometer through large mains at a pressure of 2½ inches of water. The other towns are supplied through high-pressure mains, the gas being drawn from the gasometer by the compressor and delivered directly into the high-pressure mains. A governing valve is placed

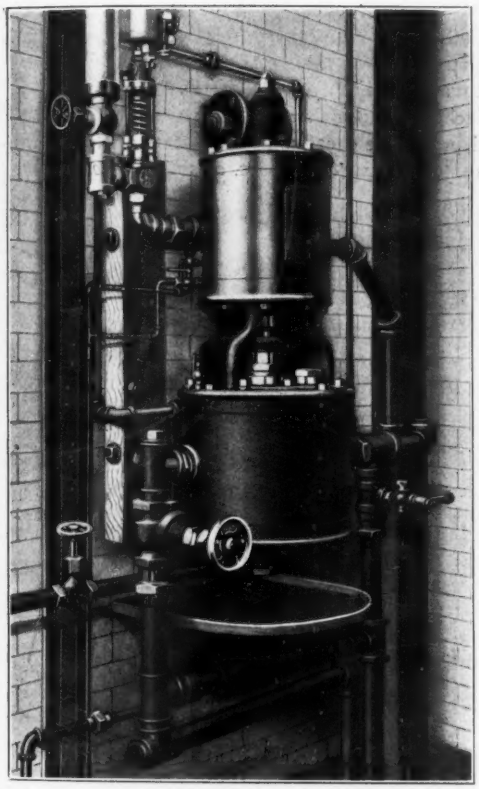


FIG. 1.—STEAM DRIVEN GAS COMPRESSOR.

in each house supplied by these high-pressure mains, which automatically reduces the pressure to the low house service pressure. About fifteen miles of two inch-pipe are already laid in the territory of about four miles' radius covered by the high-pressure system.

The gas compressing outfit in this plant consists of two 9½x13x10 inches water-jacketed compressors mounted on the wall of the engine room. The steam pressure varies from 60 to 100 pounds at different periods of the day. Only one compressor is used at a time. The low gas pressure is very constant. The high pressure varies from 10 to 14 pounds, being lowest in the day time when the steam pressure is low. The average number of

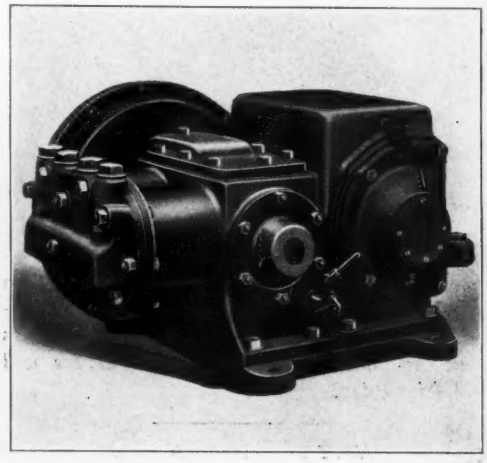


FIG. 11.--ELECTRIC DRIVEN GAS COMPRESSOR

cubic feet of gas delivered during the day time appears to be from 10 to 12 cubic feet per minute, running up to about 25 cubic feet in the late afternoon, at the time when gas is required for both lighting and cooking.

The management of the gas works expresses itself as perfectly satisfied with the compressor operation. The operating unit is shut down only occasionally, about once or twice a month, during the hours of the day when the gas consumption is lightest, to clean and oil the valves, and the storage in the mains is then enough to supply the demand until the plant can be started again. At all other times no attention whatever is paid to the compressor, outside of oiling.

The French mints are coining for the first time 25 and 10 centime pieces made of aluminum. The nominal value of the new issue will be about $12,000,000, while the actual cost will be not more than one-fifth of this. Nickel 25 centime pieces, worth nearly the same as our nickel, are in use and will not be withdrawn.

IDEAL MACHINE EFFICIENCY

With reference to machinery, there is no sound reason for considering that to put it to use implies the beginning of its deterioration; a machine, like an animal, properly proportioned to the work it is to do, should with proper control and maintenance increase in efficiency during certain of the first stages of its life. Therefore we must reach the conclusion that the real efficiency of an animal or of a machine is the average amount of work it has done as compared with what it was capable of doing, under intelligent control, during its life. An excessive output during a short period of that span is sure to result in a material reduction of the possible total. The life of a properly constructed and applied machine should be yielded up only to the inventor of its improved successor. It may be worth considering whether this was not the theory upon which the early civilized races of the East offered work animals as sacrifices on the altars of the gods.—Victor H. Becker in *Ice and Refrigeration.*

WHY IS THE SEA SALT

Sea water contains about 3½ per cent of sodium chloride and other salts. The evaporation of all the oceans would leave a mass of salt sufficient to cover the entire globe to the depth of 200 feet, and equal to the bulk, above sea level, of North and South America, or one-fourth that of the whole earth.

The theory that this enormous quantity of salt has been dissolved from continental rocks, and carried down to the sea by streams, is not tenable, because the salts found in solution in river water contain 80 per cent. of carbonate of lime and only 7 per cent. of chlorides, while common salt, or sodium chloride, constitutes 89 per cent. of the salts of sea water. Moreover, the evaporation of inland seas which has taken place in central Asia has left saline deposits very different in composition from the salts of the ocean.

It appears, therefore, that salinity must be regarded as an original property of the ocean. Suess has advanced the theory that the salts now found in the sea have been ejected by volcanoes in early stages of the earth's formation. Even now every eruption increases the quantity of water vapor, carbonic acid, and compounds of chlorine and sulphur in the atmosphere, and these substances ultimately find their way to the ocean. After every eruption of Vesuvius the crater is covered with a gleaming white layer of common salt, and the volcanoes of South America eject enormous quantities of hydrochloric acid—estimated as 30 tons daily for the volcano of Puracé, in Columbia.

This volcanic activity, now restricted to a few points of the earth's surface, must have been general in remote ages, before life appeared on the globe. The gases confined within the thin solid crust burst their bounds and found their way to the surface, bringing with them the millions of tons of chlorides which we find today in the oceans. Yet the transfer of these millions of tons is a relatively insignificant change, for on a terrestrial globe of a diameter equal to the average height of man (66½ inches), 1-16 inch would represent the greatest depth of the ocean, and the waters of the ocean contain only 3½ per cent. of solids.—*Cosmos.*

A RUBBER GLOVE DISTENDER

Skin-tight rubber gloves extending well up the arm are used by surgeons in certain dangerous operations, and the difficulty of getting them on can be imagined. The apparatus here shown makes the operation quick and simple. A glove is placed in each of the jars with an air tight fastening at the neck. The operating of the treadle makes a partial vacuum in the jars and outside the gloves, so distending them that the hands can be inserted with perfect ease.

INSECTS AS BEARERS OF DISEASE

Dr. L. O. Howard, chief of the Bureau of Entomology in a pamphlet recently issued by the Department of Agriculture, treats of insects as inimical to human health and comfort. He declares that the development of the whole state of New Jersey has been seriously retarded by mosquitoes in sections which are admirably adapted to dairy farming in other respects, but where this business had to be given up owing to the evil effect of the mosquitoes on the cattle. Many rich lands of the South cannot be developed as they would be, he says, because of the presence of the mosquito.

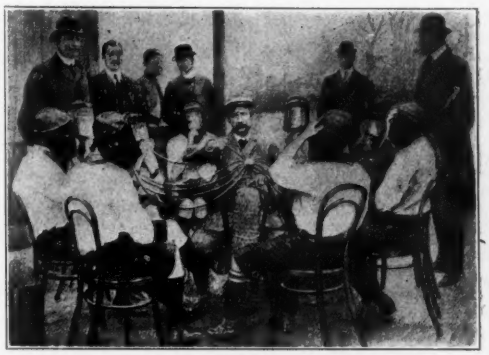
Dr. Howard declares that typhoid fever is not a national scourge, as it has been called, but rather a "national reproach," or a national crime, for its main source, the fly evil, can be controlled.

Dr. Howard says that many diseases are transmitted by insects. Yellow fever is carried by one brand of mosquito and malaria by another. The common house fly is an active agent in the dissemination of typhoid fever, Asiatic cholera and kindred intestinal disorders. The tropical disease known as filiariasis is transmitted by a species of mosquito. Bubonic plague is carried by fleas. The so-called spotted fever of the northern Rocky mountains is transmitted by a species of tick, just as Texas fever is given to cattle by the southern cattle tick.

He says that all the loss and suffering caused by these diseases are unnecessary as the diseases can be controlled by stamping out the insects that carry them.

THE GEOLOGIST IN LOUISIANA

A few years ago when an appropriation was asked for a geological survey of Louisiana it was objected that the state had no minerals and that such a survey would be worthless. To-day Louisiana is known to have the largest sulphur supply in the world, and already ships more than half of all the sulphur that is used; it has the largest available supplies of salt, its oil fields are just beginning to be developed, it has gas fields now coming under control, it has thousands of acres of excellent lignite and some coal and it also has marble quarries, so that it is really perhaps the most interesting state of the Union to the gealogist. Bulletin 7 of the Geological Survey of Louisiana has recently been issued, a handsome volume of 260 pages with numerous half tones and maps. It is devoted chiefly to salt, especially rock salt, of which the store is enormous.



STIMULATING WITH OXYGEN

Oxygen as a stimulant for athletes and a general bracer under strenuous conditions seems to be in quite common use in England, where it is hailed as almost as great an asset as long and severe training. The half-tone, from the *Illustrated London News,* shows a team of English football players inhaling oxygen before the game. In Maude Adams' play "What Every Woman Knows," the hero in an exciting electioneering scene takes a pull at an oxygen tank. Dr. Leonard Erskine Hall, lecturing at the London hospital, insisted that men who inhale oxygen before making extreme efforts are more likely to win games and break records than those who do not. He set two students boxing at the hospital, one a trained man and the other a novice. At the end of the second round the untrained man was tired out, when oxygen was administered and he began work again almost as fresh as at the beginning.

ROCK DRILL SHARPENING ARRANGEMENTS

Drill sharpening presents a department of mine costs to which no attention is given by stockholders, and only a moderate degree of attention by the mining companies. An important step was taken several years ago in reducing the cost in this department by the invention of mechanical drill sharpeners, actuated by compressed air, which have now been

introduced in the shops of nearly all the mining companies, but aside from this the companies themselves took no step to economize along this line except to introduce the machines and thus reduce the labor costs.

A radical departure is now being introduced, however, at a number of mines that will bring about even a greater saving than was secured when mechanical drill sharpeners were introduced. This is to alter the system of handling the drills. To show the comparison of the new system with the old, the method formerly employed will first be enumerated.

The drills are assembled underground by the drill boys, loaded on skips and hoisted to the surface. The ordinary rock skips are generally used for this purpose, and at times the long drills create a factor of danger, projecting above the skip bail and occasionally catching in the walls of the shaft.

At the surface the drills are piled out upon the floor by the drill boys, generally in a disorderly heap, which at times bends the steel so that it has to be heated and straightened, thus drawing its temper. Some of the companies have special skips, with compartments in which the steel is laid in an orderly manner and thus the danger of catching and bending is removed.

The drills are then loaded into wagons, in most cases, and hauled by teams to the drill shop, where from two to half a dozen drill sharpening machines are employed, depending on the size of the mine. Each team, driver and helper in this service costs about $5.50 per day.

After the drills are sharpened they are returned to the underground service by reversing the steps already described. This method requires that the drills be handled from six to ten times. Each drilling machine underground requires about 1,500 pounds of drills every 24 hours, and the cost of sharpening will at times reach $7.50 per day to keep the drills of one machine sharpened.

A complete change in this system is now being devised, to be introduced later. There is being installed in each shaft house a drill sharpening shop, consisting of a fireproof room, a forge and a drill sharpening machine, with the few other necessary tools. Two drill skips will be provided at each shaft, with compartments in which the drills will be kept assorted by lengths. When a skip load of drills comes to the surface it will be detached from the hoisting cable and shunted from the tracks of the skipway into the sharpening shop, which will be inside the shaft house structure and not 20 feet from the collar of the shaft.

In the shop will be an empty drill skip, and as each drill is taken from the loaded skip and sharpened it will be placed in the empty, until the latter is full and ready to attach to the hoisting cable to be lowered into the mine, leaving the former loaded skip empty and ready for the next consignment.

There will be only one to three hours' work at each shaft, according to the volume of rock, and the sharpeners and helpers will make their rounds from shaft to shaft handling the work. No one will be employed in the service except the drill boys necessary to make the underground distribution and the necessary sharpeners and helpers on the surface.—*Copper.*

HEART ACTION AT HIGH ALTITUDES

Dr. I. N. Hall, in the *American Journal* of the Medical Sciences, says that the dangers to the heart in high altitudes are the same as in other places, but are greatly exaggerated in some directions. The troubles most common and serious, he says, relate to inflammation of the heart muscle, hardening of the arteries, and dilatation of the heart.

The principle applied is this: The heart and lungs have an increase of functional work with each added degree of elevation and the consequent decrease in atmospheric pressure. To meet the increased demand on the circulation, the heart must enlarge if the usual amount of exercise is taken. It is not unusual for acute dilatation of the heart to occur after slight effort on the part of those whose arteries have begun to harden, and who long have been accustomed to atmospheric pressure at the sea level. The trouble with those who suffer in high altitude, the writer declares, is that they try to do too much at first, when they feel invigorated by the bracing atmosphere.

Dr. Hall adds that even an ascent in a railway train may be fatal to those who have but a narrow margin of heart strength, or the slightest exertion at such a time may produce angina pectoris. The average case of well-compensated valvular disease will do as well at a high altitude as anywhere else if the patient observes proper precautions. In such a climate he is less susceptible to acute rheumatism.

A PRECOOLING AND AIR DRYING APPARATUS

The transportation of fruits and vegetables and the delivery of them without deterioration involves much care and the employment of special methods. The ice-cooled car has become a necessity, and in connection with it means are now employed for the initial cooling

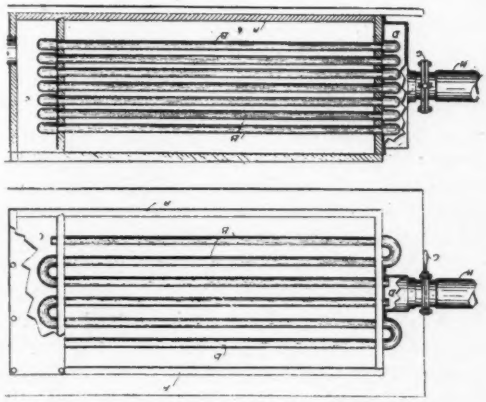
PRECOOLING A CAR LOAD.

of the load. The little half tone here reproduced from *Ice and Refrigeration* shows a portable apparatus connected by large air pipes to a loaded box car, its function being to thoroughly cool and dry the load before the trip begins.

The apparatus may be easily moved about as required or it may be mounted on wheels. The large box is fitted with coils of pipe connected with an air-tight chamber at each end of the machine. The space between these pipes is filled with 4,000 pounds of crushed ice, mixed with 500 pounds of calcium chloride or salt. An exhauster with a capacity of 3,000 cubic feet of air per minute is connected with the air chamber next to car door; the exhauster is operated by a high-speed gasoline motor running at a speed of 2,600 revolutions per minute. The insulated suction pipe is fitted to a plug covering an opening over the ice tank of the car and connected with the intake air chamber at the end of the machine opposite exhauster and engine.

The operation is described as follows: When the engine is started 2,100 cubic feet of air per minute, which is slightly more than the entire car contains, is drawn or sucked out of the top of the car, and in passing through the sets of piping in the machine is chilled to a temperature below freezing. The machine is first run a few minutes before connection is made with the car door, so that all heated air and gases generated by the freshly loaded hot fruit or vegetables is removed, and its place taken by pure air. The discharge pipe is then connected through a false door of the car and the chilled dry air is forced into the car, passing through its contents, and is again returned to the machine, maing a continuous circuit. As this air strikes the cold pipes all the moisture it contains congeals, so that only thoroughly dry, chilled air goes into the car. This constant renewal of all the air in the car each minute with the great speed of its passage and low temperature, rapidly extracts the natural heat from its contents, reducing the temperature from 85 degrees or 90 degrees down to from 40 degrees to 45 degrees in one hour or less, and eliminating all excess moisture, thus enabling the ice contained in the car to hold down the temperature, prevent incipient fermentation and secure the safe and sound arrival of the contents at destination.

For pre-cooling wrapped fruit and vegetables in crates, etc., a machine of double the above



PLAN AND SECTION OF COOLING PIPES.

size is built, which has a capacity of 6,000 cubic feet of air per minute. The larger machine has two tanks connected together, with a double exhauster, operated by one engine. It has a connection at the top of each end of the car instead of one end only, as shown in view.

The inventor of the machine is John D. Cunningham, Cincinnati.

NATIONAL VALUE OF CANALS

[The writer of the following, from the Augusta (Ga.) Herald, seems not to have heard of the New York State Barge Canal. Ed. C. A.]

France is preparing to spend $120,000,000 to construct a canal from Lyons to Arles, and $16,000,000 additional for building a branch to Marseilles. Russia, just passed through a disastrous war and a still more disastrous internal upheaval, is perfecting a gigantic plan for connecting the Baltic with the Black sea by a canal. England, so small, as to be accessible at almost all points from the ocean, yet completed the great Manchester canal only a few years ago, and while Germany dug the Kiel canal. Almost in all countries the value of canals is appreciated and canal building is being pushed, except in our own country.

It is true we are digging the Panama canal, the greatest canal enterprise ever undertaken. But this canal is not in our country. It is a thousand miles from our nearest port, and except for military purposes will be of as great benefit to other countries as to us. Of canals to develop our country we are digging none, nor are we seriously planning to dig any.

Yet canals are the greatest developers. It was her canals which made Holland, a little old marsh, a world power. It was her canal which enabled China to reach a high stage of civilization a thousand years before northern European civilization began. It was the Erie canal in New York which gave that state the lead over Virginia, superior in every way and the leader until this canal was built. Canals and national progress have always been closely connected.

In the great international trade and industrial competition we are allowing ourselves to be handicapped by not developing inland water transportation—which is and must always remain the cheapest—as is being done by competitor countries.

BAMBOO FOR AIRSHIPS

To the Filipino, as to most dwellers in the tropics, the word "bamboo" means a great deal more than it does to the inhabitant of a temperate climate. Where an American or a European would use oak, pine and chestnut, or iron, steel and brass, the Filipino uses bamboo. The importance of this product to the inhabitants of the tropics cannot be underestimated.

The name "bamboo" was originally a Malay word, but has been adopted, with slight variations, by all the world. It applies to hundreds of different kinds of grass, as well as to trees one hundred and seventy-five feet high. Yet all the varieties called bamboo are the same in structure and can be used for similar purposes. Java produces the species growing to the greatest height and the stems of these gigantic growths often have a diameter of eighteen inches.

The house of the average Filipino is built of bamboo, from the corner post to the roof. In many cases, split bamboo, overlapped, takes the place of nipa palm roofing. This forms an excellent watershed. Walls, partitions, floors, and doors are of the same material, as is the fence around the yard and the steps leading to the house.

Within doors one finds chairs, tables, beds, hammocks, stools, ladders and cupboards made of the stems of this giant grass. Milk jugs, water pots, waterpipes, flower pots, bottles of every size, boxes, cups, and fruit jars are fashioned from joints of bamboo.

Bamboo is not only lived in and eaten from, but is likewise eaten and worn. The flower of the plant makes an edible dish. The fibers of the stalk can be shredded and woven into cloth, rugs, and carpets. The cloth made of bamboo makes cool, comfortable and durable clothing. Excellent paper is made of this fiber.

Recent developments have created an entirely new demand for bamboo. It is peculiarly adaptable for airships. No other common wood is so light and at the same time so strong. Steel tubing, spruce, bamboo, and aluminum tubing have all been used to hold the engines and other mechanisms necessary for aerial navigation. Steel and aluminum tubings are objectionable on account of their weight in comparison with the woods, and recent experiments show by laboratory tests that bamboo is stronger than spruce.

Of the total estimated power at present produced by prime movers in the United States about 26,000,000 H.P. are produced by steam engines, 3,000,000 H.P. by water motors, and 800,000 H.P. by gas and oil engines.

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MILK

The routine of nature provides all our sustenance, but all which goes to the upbuilding and maintaining of our bodies requires more or less elaborate preparation by ourselves before it can be used. Except milk. Potatoes are absolutely uneatable until they are cooked. Wheat and corn must be ground and sifted and mixed and raised and kneaded and baked. Meat and fish must be boiled, stewed, roasted or fried, and so with all the other good things of the table. Milk, however, as a food is unique. Not only does it require no preparation, but so far as possible nature insists that nothing whatever shall be done to it before it enters the human stomach. In our primal and only absolutely correct use of milk three or four conditions are imperative: Milk shall not come in contact with the air and there shall be no adding to it or taking from it any ingredient; it shall be taken warm or at the normal temperature of the body, and it shall be imbibed slowly.

How completely we ignore all these conditions. We assume first that as milk is a food which nature provides for immediate and constant use it must be all right and can never be used improperly or possibly do harm; and so people drink ice cold milk by the tumblerful, and do with it other outrageous things, and when it upsets some digestive function, as it is very apt to do, the milk itself, and not the conditions of its imbibition, is assumed to be at fault, and suggestions multiply for its correction or improvement.

Surely this is all wrong. While we ignore or contravene the conditions of use upon which nature is so insistent we are not in a position to assert in any case that the milk itself requires, or can be improved by, any artificial treatment. Of course for purposes of storage and transportation the maintenance of a low temperature for the milk between its production and its consumption seems to be the best way yet discovered, and nothing is suggested in opposition. In addition to this our efforts can best be directed to the preservation of the milk in absolute purity from the moment of discharge from the animated fountains. Only when this is properly done can we rightfully begin to suggest that milk may be made safer or more nutritive and satisfying by manipulation.

For the securing of milk in its purity and

for its preservation from contamination the pneumatic devices which are coming into use seem to offer the most perfect guarantees. In our issue for August, 1908, page 4974, we described a pneumatic milker, now in extensive practical service, by the use of which the milk is transferred from the cow to the air tight pail without exposure to the atmosphere, and in the issue preceding this, page 5286, we are told of an air tight milk delivery can which may be filled at the dairy, hermetically sealed and kept in this condition until the entire contents of the can are discharged at the place of sale, sterilized compressed air expelling it in uncontaminated purity. Such milk service would seem to be the best yet attained.

THE CANALS OF GERMANY

The following striking appreciation of the canals of Germany comes to us from the pages of *The Contractor,* Chicago. It is perhaps as good a word as has been said for the New York State Barge Canal now in progress. At the same time in connection with this it would be worth while to look back to "The Railroad Side of it," in our April issue, page 5253.

It is said that the mileage of the inland waterways of Germany, if possessed by the United States *in proportion to our area,* as compared to that of Germany, would be equivalent in lineal measurement to 40 parallel waterways east and west from the Atlantic to the Pacific, and 20 parallel waterways north and south from Canada to the Gulf; and that would mean a net work of canals for a state like Ohio, say, running east and west and north and south, which would be something like 40 miles apart from boundary to boundary in all four directions.

It is with this policy that Germany has built up and is continually improving and extending her inland waterways. During the past twenty years it has expended $150,000,000 on her waterways, and it has now, in navigable rivers, canalized rivers, and inland canals, over 8,278 miles of navigable waterways. The German-Austrian and the Rhine-Elbe canals, already begun, contemplate the expenditure of nearly $350,000,000.

Regardless of the fact that the railroads are owned by the government, more properly perhaps on account of that fact, it is held an economic principle by Germany that means of transport should be open alike to all, and while the development of the railroads, contrary to the expectation of their early projectors, has made the owners of such roads the only carriers, the government of Germany, in competition with itself as a railroad carrier, is spending hundreds of millions of dollars on its canals that means of transport may be as free and open as they are upon its country roads and highways.

The Dortmund-Ems Canal, intended to divert some of the enormous Rhine traffic at Cologne, from Rotterdam to a German port at Emden, cost Germany $16,000,000. It is 116 miles long and 8 feet 3 inches deep. German commerce, during the past thirty years, has been the chief force in the remarkable prosperity of Rotterdam, Amsterdam and Antwerp.

An English political economist, after a thorough study of Germany's inland waterways, says:

"If the German waterways should be blocked for a year, the whole of Germany *would probably be ruined,* for Germany cannot live without her waterways. A further circumstance in favor of water traffic lies in this: That far more traffic can pass over a broad canal than can be sent over a railroad. It is, therefore, clear that transport by water is and must always remain, owing to its very nature, so very much cheaper than land transport, be it by road or rail; that railroads cannot possibly compete with properly organized, properly managed, properly planned, and properly equipped waterways. Hence it is economically wasteful not to extend and develop the natural and artificial waterways which a country possesses, and it is absolutely suicidal and criminal to let them fall into neglect and decay."

The Norcross marble quarry at Tuckahoe, only a dozen miles from the heart of New York City, is to be abandoned and all the machinery is being removed. The quarry has been in operation more than half a century. The last of the great buildings to be erected of the pure white stone is the Metropolitan Life Insurance Building in New York, the greatest all marble building in the world with the already world famous high tower faced with the same material.

TRADE PUBLICATIONS

BEAM AND COLUMN DATA, Northwestern Expanded Metal Company, Chicago, 36 pages, 3 by 6 inches. Formulas, diagrams, tables and general information concerning "expanded metal," usually as used for concrete reinforcement.

HUNT COAL AND ORE HANDLING MACHINERY, C. W. Hunt Company, 45 Broadway, New York, 88 pages, 6x9 inches, 240 separate cuts and half tones. Various information pertaining to this important and highly successful line of industrial equipment is here presented in compact and attractive form.

SULLIVAN AIR COMPRESSORS, Booklet 106, Sullivan Machinery Company, Chicago, 20 pages, 3¼ by 5½ inches. Slips neatly into a letter envelope; briefly describes, with dainty half tones, the chief character of the different styles of air compressors and other machinery built by the company.

TYPE K FREIGHT TRIPLE VALVE. Instruction Pamphlet No. 5030, Westinghouse Air Brake Company, Pittsburg, Pa., 30 pages 4¾x7 inches, folding plates and stiff cover for the pocket. The company's Type K Quick-Action Quick-Service, Uniform-Release, Uniform Recharge Freight Triple Valve is described with clear instructions for its manipulation under various service conditions.

TELESCOPE FEED HAMMER DRILLS, Ingersoll Rand Company, 11 Broadway, New York, 28 pages, 6x9 inches. Fine half tones and line cuts. This treats of a line of rock drills of rapidly extending appreciation and use. They are light drills in which the steel does not reciprocate, but is held constantly against the rock and is struck by the hammer as in hand drilling, but with vastly greater rapidity. The telescope feed automatically maintains the constant pressure of the steel against the rock. Both the Ingersoll "Crown" and the Rand "Imperial" hammers are described, with their manipulation under various conditions.

AIR CURES WATER HAMMER

Water hammer in some of the large mains of the Detroit Water Works, where the direct pumping system is used, has caused the engineers much anxiety, but the trouble has been materially reduced by the application of an air chamber as described in the annual report of the engineer, Mr. George H. Fenkell. About half a mile from the pumps an emergency station was built and equipped with a 1000 cu. ft. air chamber, an air compressor, with electric motor and devices making the air pressure maintenance automatic. The air chamber is connected to two 42-in. force mains, and since it has been installed the pressure gages some miles distant on a 24-in. connecting main have shown a reduction of the pressure fluctuations from about 12 lb. to 3 lb., while the hammer on one of the 24 in. mains, to which the air chamber is directly connected, has been reduced from 10 lb. to 4 lb.

CLAY

By W. N. LOGAN.

ORIGIN AND CLASSIFICATION OF CLAY.

Clay is a soft rock, smooth or greasy to the touch and, mixed with water, it can be molded into any shape. This property is called plasticity. Clay is a mechanical mixture of many minerals whose proportion varies greatly. Aluminous clays contain much kaolinite, the basis of clay. Clays may be sandy, limy, or rusty with iron oxide.

Loess is a silty material of fine particles of clay, sand and lime and some organic matter It may contain concretions of lime carbonate and fresh-water shells. Marl is a mixture of sand and limy material of marine or lacustrine origin. Shale is compressed clay. The decomposition and alteration of rocks containing silicates of alumimum are the sources of clay. The silicates, called feldspars, forming the principal constituent of granite and eruptive igneous rocks is a fruitful source. The decomposition of these rocks is by water carrying carbonic acid which attacks the potash and soda in the feldspar. Thus aluminum uniting with silicic acid forms silicates free from other bases which are carried away by waters. Aluminum silicates thus formed are kaolinite. This forms beds of rock called kaolin. It is the base of clays, whose purity depends on the percentage of this element. Numerous impurities are liable to be associated with clay and the value, or the contrary, of the impurities depends on the purposes for which it is used.

There are residual clays derived from rocks in place and transported clays, such as are found in streams, lakes, glacial deposits and banks formed by wind. In the case of resi-

dual clays their depth depends on the amount of surface decomposition the rocks, such as granite, have undergone; rarely is this as much as 100 ft. The gouge commonly met in mines, resulting from decomposition of feldspathic porphyries, is a kaolin, usually containing too many impurities for use in chinaware. Clays now found in place and forming thick beds of hardened shale were originally transported by seas or other bodies of water. During the glacial epoch, rocks were ground to powder and deposited in beds by streams, forming residual clays known as "till."

USES OF CLAY.

Common brick needs no description. Vitrified bricks are made of clay shales for pavement; they are compact, non-porous, stony, very hard and stand much pressure. Fire brick is from highly refractory clay; tile clay from common clay or fire clay or both. Flue clay and stoneware clay are from clay or shale. China clay, or kaolinite, used for porcelain; cement clay used in manufacture of Portland cement is mixed with limestone, then pulverized, burnt to vitrification and reground to flour; paper clay, used as a filler for printing paper, wall paper, etc., is used in raw state; fuller's earth, used to refine crude oil; adulterant clay, used in soap, paint and food; terra-cotta, used for terra-cotta brick.

Weathered shales exhibit a higher degree of plasticity than the unweathered. The chemical compounds of clay are silica, alumina, iron oxide, lime oxide, magnesia and alkalies. Minerals in clay are kaolinite, silica, iron, gypsum, feldspar, mica and hornblende. The physical properties consist of structure and shrinkage; the color of clay is very variable.

A clay may be roughly tested in the field by its feel to the touch, odor when moistened, and taste. Plasticity is a valuable quality of some clays, so is the degree of fusibility. Bonding power is the power of a clay to hold together non-plastic materials. Tensile strength is the resistance clay offers to pull. *Mississippi State Geological Survey.*

THE DEEPEST METAL MINES OF THE WORLD

The deepest gold mine is the Victoria Quarts at Bendigo, in Australia; this mine has a vertical shaft that has been sunk to 4,300 ft. and a winze that is 225 ft. deeper, making the total depth 4,525 ft.

In California, the main shaft of the North Star mine at Grass Valley is down 5,400 ft. on the vein, which has a dip of 28 degrees, so that the maximum vertical depth is only 2,086 ft. The neighboring Empire mine has an incline shaft that is down 3,500 ft. on the vein but only 1,570 ft. vertically below the surface.

The Kennedy, on the Mother Lode, in Amador County, is one of the famous mines of California. The maximum depth attained is 3,254 ft.

On the Comstock, the deepest mining now in progress is on the 2,300-ft. level of the Ophir, which is 2,552 ft. below the Gould & Curry outcrop. The greatest depth attained on the Comstock was in a winze in the Mexican mine, which, before the flooding of the workings in 1884, reached down to 3,308 ft., or 3,554 ft. below the Gould & Curry outcrop.

On the Rand, the shaft of the Cinderella Deep is down to 4,200 ft. and that of the Jupiter to 4,230 ft. Johannesburg, before long, will have many deep mines. In Brazil, the Morro Velho shaft of the St. John del Rey has reached a depth of 4,264 ft.

But the deepest metal mines are still in the Lake Superior copper region. There the Red Jacket shaft of the Calumet & Hecla mine is 4,920 ft. vertical; while the Tamarack has two shafts over 5,000 ft. deep, namely, No. 5, which is 5,180 ft., and No. 3, which is 5,230 ft. vertical. These Tamarack shafts were sunk to extract ore from the copper lode first exploited in the Calumet & Hecla, and they cut a lode having a dip of 38 degrees at a vertical depth of 4,660 ft. By attaining a depth of one mile underground and by showing with what ease operations are conducted at that great depth, these Lake Superior mines have demonstrated that man is likely to be able to penetrate at least as profoundly into the earth as the ore persists.—*Mining and Scientific Press.*

WEALTH IN SAVINGS

Say! Have you read that book of Andrew Carnegie's yet? Well, it's called the "Empire of Business," and it's all right! All the way through he shows you've *got to save money!* I guess "Andy" knows what he's talking about when he says, "Be thrifty." Why, out there at Gary, Ind., in the new steel plant, the gas from the blast furnaces—gas such as for fifty

years they used to manufacture Pittsburg's famous atmosphere with—is now all saved, every bit of it, and all the big machinery and electric lights are run from this gas. They get 500,000 horsepower right along, and they say they don't have to buy coal for power. It's pretty near like getting something for nothing ain't it? Of course, they have to put in a dust catcher and washing machines, so the gas won't spoil the machinery, but the fellow that won't spend a hundred dollars when it will save him fifty dollars a year is about ready for the scrap pile, in my opinion, when it comes to knowing what the word *investment* means.

Maybe old man Armour didn't *invest* some money out there in South Chicago for machinery and brains, too! Why now, they tell me, they've got the "by-products of pig" down to such a fine point that for every ton of hogs they buy they sell a ton and a tenth, counting the wrappings!

And I guess John D. is pretty wise to this saving game, all right. They used to pump petroleum, get some gasolene and coal oil out of it, and throw the rest away. But nowadays the old chemists dig down in their queer old laboratories, and then we hear of a new "vaseline" on the market, or a "non-fluid oil," or a new axle grease. And so it goes every year, more and more usefulness out of the same old stuff that we ordinary folks thought didn't contain anything new at all.

Whether we read about a chemist fellow, or the expert butcher, or the steel men that save money, they always use the term "by-product." Now, that sounds kind o' swell and dignified, but I guess it's all right when you think about it. "By" really means "on the side," or extra. Just like when you order roast beef, and the waitress hollers: "Potatoes on the side," why you get them for nothing. So "by-product," when you boil it down, just means that you get something where you used to get nothing, 'cause you had been throwing it away.—*Power and the Engineer.*

A WATERWORKS AIR LIFT

An interesting air lift pumping plant is in operation as part of the water supply of Palmerton, Ontario. There are two 8-in. wells 300 ft. deep in a limestone stratum, the water normally rising to within 16 ft. of the surface. A 5-in. discharge pipe is placed inside the casing with a 1½-in. air pipe discharging at a depth of 100 ft. The compressor is a duplex machine with 12x12 in. air cylinders, the steam end being compound and condensing, so that good economy is secured. In a 10-hour test each pump delivered 250 gallons per minute, lowering the water level from 16 to 40 ft., at which depth it remained. When discharging 450 gallons per minute with an average lift of 39 ft. the free air used was 0.38 cu. ft. per gallon.

NOTES

The forty-second annual convention of the American Railway Master Mechanics' Association will be held on Young's Million Dollar Pier, Atlantic City, N. J., Wednesday, Thursday and Friday, June 16, 17 and 18, 1909.

The forty-third annual convention of the Master Car Builders' Association will be held at the same place Monday, Tuesday and Wednesday, June 21, 22 and 23, 1909.

The San Francisco branch office and warerooms of the Sullivan Machinery Company are now located at 461 Market street, in the Sheldon Building, instead of at 26 Fremont street, as heretofore.

In the New York Singer building or tower there are three elevators which travel 479 feet, and one, which is the highest rise elevator at present in use in a commercial building, rises 546 feet, to the 40th floor.

According to the reports of the geological survey, 58,000,000,000 cubic feet of coal gas was made in the United States during 1907 by 513 companies. Of this product 54,600,000,000 cubic feet was sold for $36,327,897.

Small air hoists mounted on a bar are used in some of the mines at Mount Morgan, New South Wales, Australia. These are easily put up, the bar being placed vertically, and are used instead of a windlass in sinking winzes.

Until recently the deepest borehole in the world was that at Rybnik, Upper Silesia, 2,003 meters (6,571 feet). At Cruchow in the same

district a hole commenced in December, 1906, with a diameter of 16 inches has now reached a depth of 2,156 meters and it is to be continued if possible to 2,250 meters, or 1.4 mile.

The breaking of an air brake hose recently caused the wreck of a freight train at Elmira, N. Y. The cars in the middle of the train buckled, two of them being forced into a vertical position and falling over against a two story wooden house. The crash of the cars and the subsequent wrecking operations completely demolished the house.

A plan for a tunnel below the St. Lawrence River at Quebec was recently submitted to the Montreal Board of Trade. It is claimed by Mr. J. S. Armstrong, the engineer who made the proposal, that it would cost no more than the proposed Quebec bridge, and that it would have the advantage of presenting no obstruction to navigation. Provision would be made for four lines of railroad track and for vehicular traffic.

Organic remains in sandstone are sometimes replaced by copper, such as fossil imprints of plants, branches and trunks of trees and bones of animals. Copper solutions have a natural affinity for organic substances. Silver also is sometimes found replacing organic remains. Tin solutions from tin deposits have replaced ancient deer horns in Cornwall. In the Silver Reef sandstones of Utah, chloride of silver replaced fossil plants.

A cupola frequently melts best on a very cold winter's day. The reason is that, if the blower takes air from out of doors, the moisture has been frozen out of the air. The cold also makes the air more dense. With each revolution of the blower the cupola then gets an increased quantity of oxygen with less than the usual amount of moisture, conditions which tend to produce a hotter fire and more uniform working.

The first operation in this country upon a human being in which the cavity of the thorax was opened while the lungs were inflated from a chamber containing air at a greater pressure than that of the atmosphere was performed recently at the German Hospital by Dr. Willy Meyer. Many operations in the thorax have been difficult to perform, and others impossible because as soon as the cavity of the thorax is opened the lungs collapse because of the atmospheric pressure.

There are grown in the United States about 13,000,000 bales of cotton annually, each bale weighing 500 pounds, which amounts to six billion, five hundred million (6,500,000,000) pounds of cotton. For every pound of cotton there are 3 pounds of seed, giving a yield of 19,500,000,000 pounds of seed, valued at about $200,000,000. There are about 800 cotton-oil mills in the United States.

Prof. Charles B. Richards, for the last twenty-five years head of the mechanical engineering department in the Sheffield Scientific School, Yale University, has announced his intention of resigning. He was one of the founders (1880) of the American Society of Mechanical Engineers and was Commissioner to the Paris Exposition of 1889. While not yet thirty years old, and working as a consulting engineer in New York, impelled by Charles T. Porter, he invented the modern steam engine indicator, for which invention he received the decoration of the Legion of Honor of France.

The C. & G. Cooper Company, Mount Vernon, Ohio, recently forwarded an entire trainload of machinery comprising a single engine for the Tenn. C. I. & R. Co. at Eusley, Ala. This was a 42 and 78x54 inch cross-compound condensing Cooper Corliss engine. Delivery was promised in four months from receipt of necessary information, but it was made forty days ahead of time. It is to drive a 2,500 kilowatt Crocker-Wheeler alternator and is proportioned for heavy overloads. A similar engine is being completed for the Packard Motor Car Co. of Detroit.

The rock temperature in Bendigo mines, according to the report for 1907 of A. H. Merrin, chief mining inspector for Victoria, Australia, increases at the rate of 1 deg. Fah. for each 75 ft. below the zone of invariable temperature. At 4000 ft. the temperature due to the heat of the rocks is 110 deg. Fah. At this depth the temperature of the water issuing from the rocks is 114 deg. Fah. Under average underground conditions, when there is water in the downcast shaft, the actual temp-

erature in the stopes will be somewhere between 75 deg. and 110 deg. Fah., depending upon the quantity of air entering the stope and the length of time the air is in contact with the rock before entering the stope.

One of the great scourges of mining is miner's phthisis, or miner's consumption, a disease formerly thought to be caused largely by dampness, cold or powder smoke, but now known to be caused by rock dust inhaled into the lungs. The fine, sharp particles of the dust become imbedded in the air cells of the lungs and set up an irritation that often results scriously. The trouble is in no way due to poisonous ingredients of the mineral matter, but entirely to the mechanical irritation. Miners in metalliferous mines are particularly subject to miner's phthisis, as the dust produced in these mines is often hard and glassy, and it has been noted that in mines where this dust is most common this disease is most prevalent.

A ship canal across Scotland is now being discussed. At the present time there are two waterways across Scotland. One of them is the Caledonian canal, which has a large number of locks and will receive vessels up to 160 ft. in length. The other is the Forth and Clyde canal, 39 miles long, 27 ft. wide at the bottom and 10 ft. deep, which was opened for traffic in 1790. None of the projects under discussion relate to the Caledonian canal, but there are several with regard to the other. One of them is to enlarge it to accommodate the heaviest battleship of the navy, and the other is to alter it into a tidal canal with hydraulic lifts at each end. Other plans for a ship canal have been proposed.

In the metric system fluid pressure, as of steam, air, etc., is stated in kilograms per square centimeter. One kilogram per square centimeter is equal to 14.22 pounds per square inch, and this number is used as a multiplier in converting the metric reading into English. For converting inch-pound pressures into metric the reciprocal of this number, .070323, is the multiplier. The kilogram per square centimeter is inconveniently near to the normal atmospheric pressure at sea level, 14.22 being about 3.3 per cent. less than the 14.7 pounds usually assumed. The atmospheric pressure at an altitude of 800 feet is very nearly a kilogram per square centimeter.

If the specifying architect would only take the trouble to inquire a little, he would find that American quarries produce every possible requisite for the most elaborate trim, as well as the most attractive body stone, for every structure. The development of our quarries a generation ago was insignificant compared with that of to-day. No industry has shown anything like a comparative improvement during the last decade with the stone producers of this country. With better equipment and raw material fully as good or better than foreign quarries can show, American quarries now offer selections that outrank the world.—*Rock Products.*

An interesting demonstration was recently given in England of an electric-generating plant operated by a windmill. The wind wheel was 16 feet in diameter, and was mounted on a tower 50 feet high. Three tails were provided, one at the side being fixed, and the other two adapted to be rotated on a horizontal axis, so that when they were turned into the vertical plane they would hold the wheel into the wind, and when turned in the horizontal plane, the fixed tail would throw the plane of the wheel in the plane of the wind. The two movable tails were arranged to swing out of the vertical position, automatically, when the velocity of the wind rose above a certain amount. A two-kilowat generator was driven by the wheel at speeds varying from 800 to 1,600 revolutions per minute.—*Scientific American.*

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

APRIL 6.

916,999. AIR-HEATER FOR GASOLENE-ENGINES. CHARLES B. CHAMBERS, Milo, Mo.

917,071. PNEUMATIC-TIRE VALVE. THOMAS B. HUESTIS, Bristol, R. I.

917,074. ROCK-DRILL. CORWALL JACKSON, Madison, Wis.

917,081. COMBINED MOTOR AND AIR-COMPRESSOR. WINCENTY KRYGOWSKI, Chicopee Falls, Mass.

1. In an apparatus of the character described, a reservoir for compressed air, and a combined motor air compressor *internally of the reservoir,* the compressed air delivery conduit terminating within the reservoir.

917,091. AIR-BRAKE SYSTEM. GEORGE MACLOSKIE, Schenectady, N. Y.

917,185. APPARATUS FOR TEMPERING AND PURIFYING AIR. WILLIAM E. TAYLOR, Toledo, Ohio.

917,193. FLUID-PRESSURE BRAKE. WALTER V. TURNER, Edgewood, Pa.

917,194. FLUID-PRESSURE BRAKE. WALTER V. TURNER, Edgewood, Pa.

917,242. PNEUMATIC HAMMER. JOSEPH BOYER, Detroit, Mich.

917,300. FLUID-PRESSURE CONTROLLER. WILLIAM G. HUGHES, Pittsburg, Pa.

917,317. AIR-ENGINE. CHRISTOPHER JOHN LAKE, Bridgeport, Conn.

917,345. FLUID-PRESSURE-CONTROLLING VALVE. FRANK A. NELSON, Minneapolis, Minn.

917,445. TROLLEY. ALBERT S. JANIN, New York, N. Y.

1. In trolleys for locomotives and trains, a collapsible diamond-shaped frame, spring and pneumatically controlled, and an auxiliary lifting device for the frame, said lifting device serving as a cushion for the frame when lowered.

917,619. AIR-DRIER FOR PNEUMATIC LINES. JAMES L. LAMB and TIMOTHY C. SHEEHAN, Philadelphia, Pa.

1. An air drier for a pneumatic system comprising a perforated surface and a mass of mechanically absorbent spongy material interposed within the line of traverse of the air of the pneumatic system, the spongy material being supported upon the perforated surface, whereby the moisture which has been removed by the spongy material from the air is in turn drained from the spongy material.

917,647. WAVE AND TIDE MOTOR. ELBERT T. ODOM, Birmingham, Ala.

917,688. PNEUMATIC HOIST. BRUCE WALTER, Pittsburg, Pa.

917,695. AIR-SHIP. HARRY WELLS, Oakland, Cal.

917,731. ROCK-DRILL. CORWILL JACKSON, Madison, Wis.

APRIL 13.

917,756. HOT-AIR HEATING PLANT. ROBERT G. ELLIOTT, Toledo, Ohio.

917,897. AUTOMATIC CONTROLLING MECHANISM FOR FLUID-PRESSURE SYSTEMS. WALTER J. RICHARDS, Milwaukee, Wis.

917,935. VESSEL-PROPELLING APPARATUS. JOHN ELNIFF, Kansas City, Mo.

1. A vessel provided with a plurality of ports in its hull below the level of the water on which the vessel floats, plates secured externaly to the vessel near said ports having channels communicating at their opposite ends with said ports and the water sustaining the vessel, certain of said channels communicating with the water sustaining the vessel, at their front ends and the remainder at their rear ends with respect to the prow and stern of the vessel, and *means for forcing air* through said ports and channels.

917,942. WINDMILL. THOMAS O. HARSTAD, Windom, Minn.

917,974. TUNNELING-MACHINE. EDWARD F. TERREY, New York, N. Y.

917,992. FLUID HOISTING MACHINERY. CLINTON F. BLAKE, Chicago, and CHRISTIAN W. AVELING, Morgan Park, Ill.

917,993. DUST-REMOVING PNEUMATIC MACHINE. JULES R. BLUM, Paris, France.

918,089. GAS AND OXYGEN BURNER. HERMANN RIESS, Reinickendorf-West, near Berlin, Germany.

918,194. ELECTRIC AIR-COMPRESSOR. AUGUSTINE J. POCOCK and RICHARD E. ALLGIRE, Dayton, Ohio.

918,336. AERIAL NAVIGATION. CHRISTOPHER JOHN LAKE, Bridgeport, Conn.

1. In a vessel or vehicle, the combination of longitudinal air passages and substantially vertical air passages, each of said passages having a contracted central portion and expanding in either direction therefrom to enlarged open ends, means for producing a heated elastic fluid under pressure and means for discharging said fluid from points intermediate the ends of the conduits, and their contracted central portions in such manner as to impel air therethrough, the air being heated and expanded by said fluid during its traverse of the expanding portions of the conduits.

918,410. AIR-SHIP. JAMES M. WRIGHT, Keokuk, Iowa

918,468. ART OR PROCESS OF PRODUCING LIQUID AIR. JAMES F. PLACE, Glenridge, N. J.

918,470. AIR-BRAKE. EDMUND B. POWERS, New York, N. Y.

APRIL 20.

918,510. TUNNEL-VENTILATING DEVICE. HOWARD CONSTABLE, New York, N. Y.

918,574. AIR-CLEANING SYSTEM. WILLIAM C. MAYO and JOHN HOULEHAN, El Paso, Tex.

918,589. APPARATUS FOR SEPARATING NITROGEN AND OXYGEN FROM MIXTURES CONTAINING THEM. RAOUL P. PICTET, Berlin, Germany.

918,596. MEANS FOR PROTECTING SUBMERGED MOTORS. HENRY G. REIST, Schenectady, N. Y.

1. In combination, an electric motor, an air-tight inclosing casing therefor provided with an outlet near the bottom and a compressed air inlet, and a source of compressed air external to said casing arranged to force air into said inlet whereby the fluid in which the casing is submerged will not rise to a level in said casing much above said outlet.

918,652. DRIVING MECHANISM FOR PLANER-PLATENS. JOHN H. B. BRYAN, Buffalo, N. Y.

1. A driving mechanism for planer platens comprisng two pneumatic clutches which are constructed to move the platen in opposite directions, a main air supply pipe, two branch pipes or conduits connecting with said clutches, a reversing valve for connecting each branch pipe or conduit either with the main air supply pipe or with an exhaust, and means constructed to permit the air to flow freely forward through said branch pipes or conduits but retard the backward flow of the air through the latter, substantially as set forth.

918,675. AIR-BRAKE SYSTEM. JOHN HUGHES, Jackson, Mich.

918,754. AIR-BRUSH. FREDERICK J. LEDERER, Buffalo, N. Y.

918,794. PNEUMATIC COTTON-PICKING SYSTEM. JOHN S. THURMAN, St. Louis, Mo.

918,795. SUCTION-HEAD FOR VACUUM COTTON-PICKERS. JOHN S. THURMAN, St. Louis, Mo.

918,879. COMBINED AIR AND GAS MIXER AND CONTROLLER. JOHN H. MARTINDALE, Cleveland, Ohio.

918,894. FAN-BLOWER. AMON T. NOE, Parnassus, Pa.

918,896. PNEUMATIC RENOVATOR. AMON T. NOE, Parnassus, Pa.

918,930. SELF-CLOSING VALVE FOR VACUUM CLEANING-TOOLS. JOHN S. THURMAN, St. Louis, Mo.

918,931. COMBINED DISINFECTING AND GREASE-REMOVING APPARATUS. JOHN S. THURMAN, St. Louis, Mo.

918,932. DUST-DISPLAY DEVICE FOR VACUUM CLEANING-TOOLS. JOHN S. THURMAN, St. Louis, Mo.

918,968. SUBAQUEOUS ROCK-BREAKER. BARTON H. COFFEY, Boston, Mass.

919,035. PNEUMATIC HAMMER. VICTOR E. LANE, Berwick, Pa.

919,079. SIPHON-PUMP. WILLIAM L. RICHARDS, Wilkes-Barre, Pa.

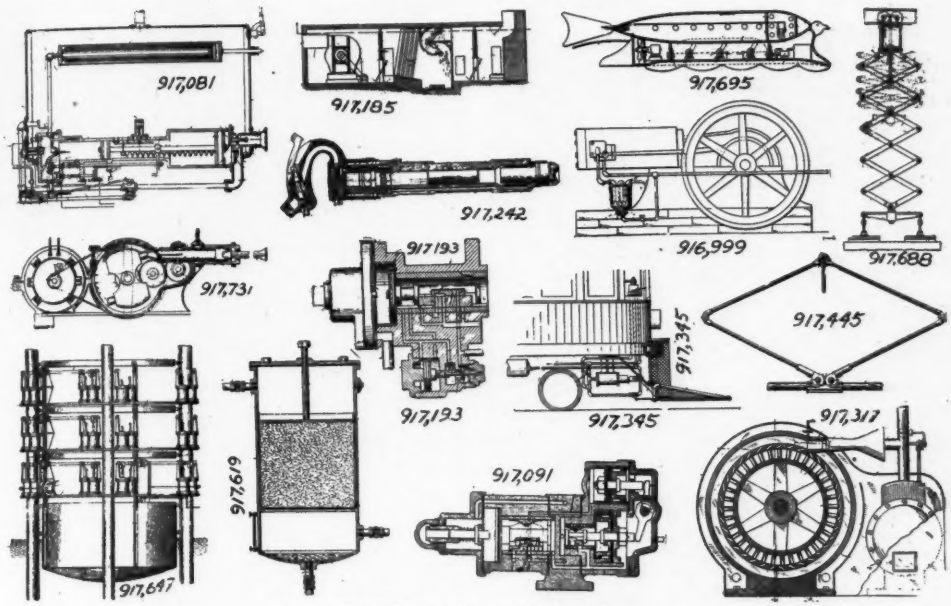
919,142. APPARATUS FOR PUMPING OIL FROM PETROLEUM-WELLS. KAREL E. EHRMANN, Bajoeng Lentjir, Sumatra.

919,270. HAMMER-DRILL. DANIEL S. WAUGH, Denver, Colo.

12,945. PNEUMATIC TOOL. WELLS WHEELER, Swissvale, Pa. (Reissue).

APRIL 27.

919,304. PNEUMATIC-DESPATCH-TUBE APPARATUS. LOUIS G. BARTLETT, Somerville, Mass.



PNEUMATIC PATENTS. APRIL 6.

919,326. FLUID-PRESSURE MOTOR. PHILIP J. DARLINGTON, Plainville, Conn.

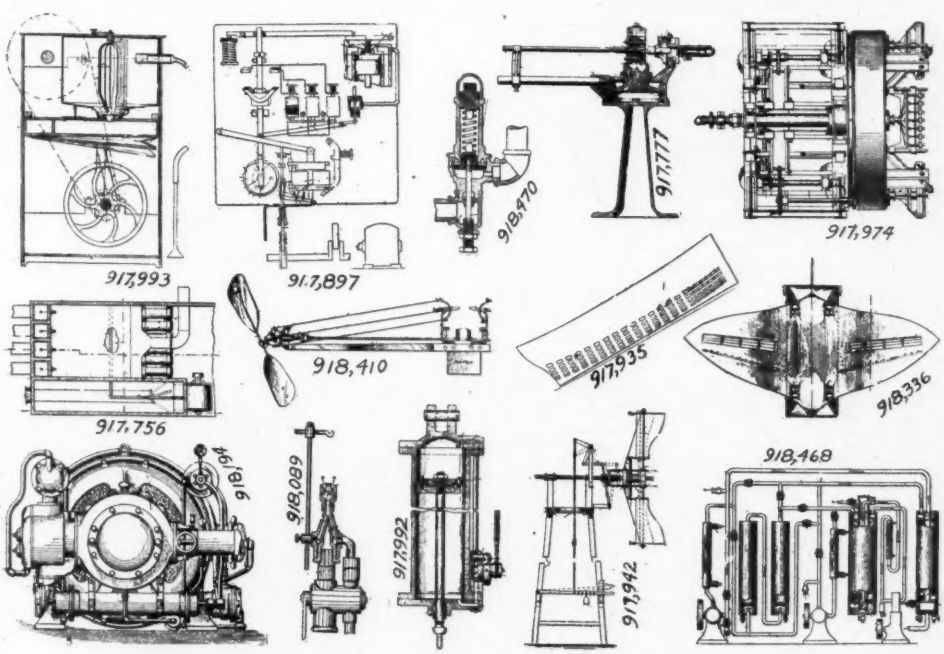
919,369. SUCTION APPARATUS FOR PNEUMATIC CLEANING SYSTEMS. WILLIAM LOCKE, Westfield, and ELIAS LOCKE, Westfield, and ELIAS B. DUNN, East Orange, N. J.

919,403. APPARATUS FOR THE PRODUCTION OF OZONE. ALEXANDER VOSMAER, Philadelphia, Pa.

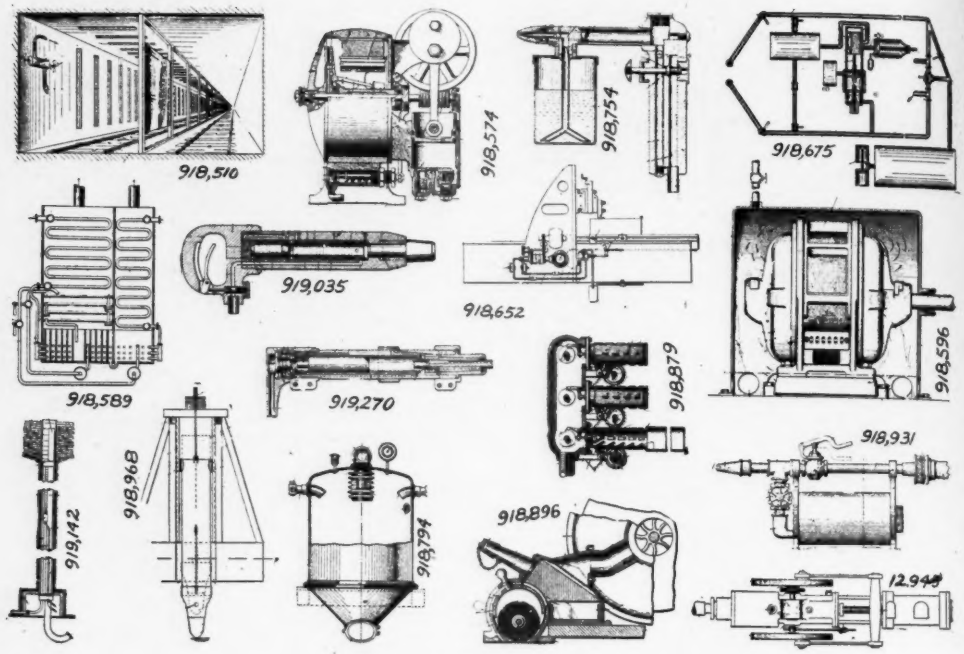
919,445. OZONIZER. ANTHONY LOHMAN, Philadelphia, Pa.

919,484. AIR PUMP OR COMPRESSOR. CHARLES O. SOBINSKI, St. Louis, Mo.

919,606. PNEUMATIC SUCTION CLEANING



PNEUMATIC PATENTS. APRIL 13.



PNEUMATIC PATENTS, APRIL 20.

APPARATUS. WILLIAM LOCKE, Westfield, and ELIAS B. DUNN, East Orange, N. J.

919,609. AUTOMATIC AIR-BRAKE SYSTEM. GEORGE MACLOSKIE, Schenectady, N. Y.

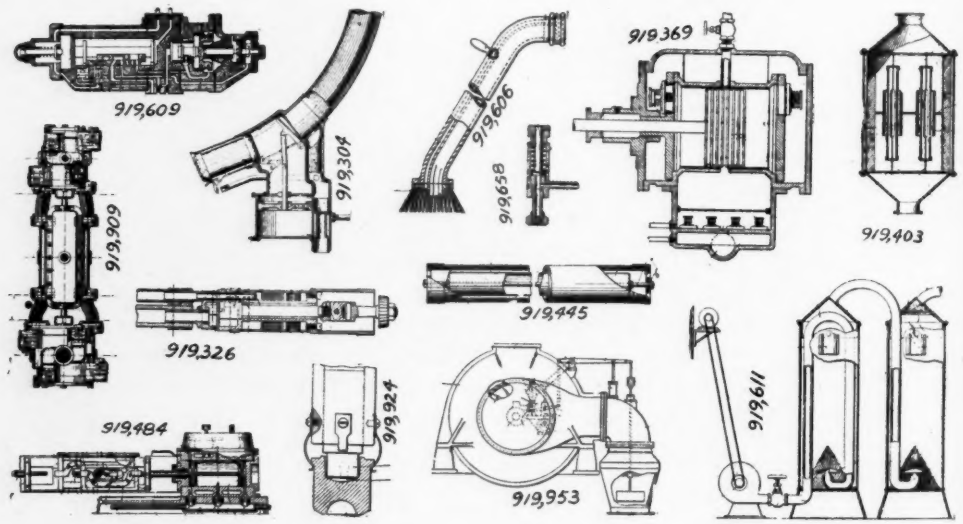
919,611. AIR-COOLER. CHARLES F. MARTIN. Little Rock, Ark.

919,658. AIR-VALVE. VICTOR C. WASHBURN, Clifton Springs, N. Y.

919,909. COMPOUND AIR-COMPRESSOR. ALFRED H. MEECH, Chatham, N. Y.

919,924. BUTTON-SET FOR PNEUMATIC HAMMERS. ARTHUR J. MCQUAIDE, Canton, Ohio.

919,953. GOVERNING MECHANISM FOR AIR-COMPRESSORS. RICHARD H. RICE, Lynn, Mass.



PNEUMATIC PATENTS, APRIL 27.

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Stearns-Roger Mfg. Co.
Utah Mining Machinery & Supply Co.

Pumps, Air.
Blaisdell Machinery Co.
Cameron Steam Pump Works, A. S.
Harris Air Pump Co.
Ingersoll-Rand Co.
McKiernan Drill Co.
Stearns-Roger Mfg. Co.
Utah Mining Machinery & Supply Co.
Westinghouse Air Brake Co.

Pumps, Pneumatic Displacement.
Harris Air Pump Co.
Ingersoll-Rand Co.
McKiernan Drill Co.
Stearns-Roger Mfg. Co.
Utah Mining Machinery & Supply Co.
Westinghouse Air Brake Co.

Pumps, Steam.
Cameron Steam Pump Works, A. S.
Stearns-Roger Mfg. Co.
Utah Mining Machinery & Supply Co.
Westinghouse Air Brake Co.

Quarrying Machinery.
Blaisdell Machinery Co.
Bury Compressor Co.
Cameron Steam Pump Works, A. S.
Ingersoll-Rand Co.
McKiernan Drill Co.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.
Utah Mining Machinery & Supply Co.

Rock Drills, Air and Steam.
Blaisdell Machinery Co.
Ingersoll-Rand Co.
McKiernan Drill Co.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.
Utah Mining Machinery & Supply Co.

Rock Drills, Electric-Air.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.
Utah Mining Machinery & Supply Co.

Sand Blast Machinery.
American Diamond Sand Blast Co.
Druckleib, C.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Stone Tools, Pneumatic.
Ingersoll-Rand Co.
McKiernan Drill Co.
Stearns-Roger Mfg. Co.
Utah Mining Machinery & Supply Co.

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